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ABSTRACT

Estimated and projected requirements for health personnel at the state and national levels are presented, based on a review of 56 health manpower requirements studies published between 1976 and 1986. The studies were grouped according to four methodological approaches used to make estimates: health (or medical) needs approach, professional judgment-based approach, demand/productivity-based approaches, and prepaid group practice approach. For each study, underlying factors and/or assumptions inherent in the methodology were coded (e.g., morbidity/demand-related factors, supply/productivity-related factors, delivery system-related factors). Estimates of health manpower requirements from the studies were converted to ratios of health professionals per 100,000 population. After briefly describing the national and state studies, ratio tables are presented that indicate the range of selected requirements ratios by health profession group, and requirements ratios for each health profession group according to the specific study. The longest section of the document consists of abstracts of the studies, which include bibliographic information, the health fields covered, purpose, methodology, and underlying factors and assumptions. Studies that were reviewed but excluded from the analysis are identified in an appendix, and bibliographies of both the abstracted and the excluded studies are also appended. (SW)

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A REVIEW OF HEALTH PROFESSIONS REQUIREMENTS STUDIES

HRP-0906789

March 1986

U.S. DEPARTMENT OF
HEALTH & HUMAN SERVICES
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PREFACE

In recent years there has been considerable discussion of the impact of the increasing supply of health professionals and considerable interest in determining and defining the most appropriate goals for health professions supply currently and in the future. The Bureau of Health Professions regularly receives requests for information on what individuals and organizations involved in health manpower planning and analysis are prescribing as appropriate manpower requirements standards.

The objective of this report is to serve as a source of information on health professions requirements studies recently reported in the literature. It identifies and summarizes the estimated and projected requirements for health personnel at the State and national levels and presents the assumptions and data bases underlying these estimates in order to facilitate their evaluation. This report is intended to update and expand the information provided in DHEW Publication No. (HRA) 77-22, Review of Health Manpower Population Requirements Standards.

This report was prepared by SRA Technologies, Inc., under contract to the Bureau of Health Professions, Health Resources and Services Administration. Kim Smith served as the principal investigator for SRA Technologies, Inc. Ernell Spratley and John Drabek, Ph.D., of the Office of Data Analysis and Management, Howard V. Stambler, Director, served as the Project Officers.

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Chapter 1

INTRODUCTION

Health manpower issues of the 1980s include concern and interest in the possible impact of the increasing health professionals and in what appears to be generally accepted and clearly defined goals for health professions supply. Such interest has heightened during very recent years with the continued rapid growth of health care costs and the costs of obtaining and providing for the education of health care professionals, and the increasing emphasis on the efficient use of health care resources.

Health manpower planners and analysts and others involved in trying to determine whether there is presently or will be in the future, a sufficient number of health practitioners of a certain kind to provide an acceptable level of health care regularly inquire about appropriate "standards" for health manpower requirements. While a variety of methodologies have been developed in order to estimate health manpower requirements, producing a considerable range of estimates for any given profession, no single methodology has been found to be universally acceptable or the most adequate for all situations. Additionally, a specific type of health manpower requirements methodology may even differ on many levels such as purpose, assumptions, underlying factors, data and geographical area of concern. Thus, there is no consensus on what any standard should attempt to measure nor how the measurement should be made.

In order to update and expand upon information provided in a 1977 report DHEW Pub. No. (HRA) 77-22 Review of Health Manpower Population Requirements Standards, SRA Technologies, Inc., under contract to the Bureau of Health Professions has searched the literature and contacted numbers of organizations and individuals involved in health manpower planning efforts. The primary objective of the present and the previous study was to identify, locate and describe health manpower requirements studies recently presented in the literature in order to produce a report that would assist health manpower analysts and planners in their own manpower requirements assessment efforts. By presenting a summary and analysis of the requirements estimates published in the literature this report should allow planners and analysts to focus on those studies that present methodologies of particular interest, while eliminating the need for initiating a time-consuming inventory and evaluation of studies. It is also useful for comparative purposes in that it provides a summary of what other analysts and planners are prescribing as appropriate requirements levels for specific professions and geographical areas.

An important part of this study is the derivation and presentation of manpower to population requirements ratios from the requirements estimates contained in the literature. However, these ratios have not been endorsed as standards by BHPr and should not be interpreted as the "most appropriate" or an "approved" set of requirements ratios. Rather, these ratios were identified, developed, and presented for illustrative and comparative purposes, demonstrating the variety of results that have been obtained by the application of the various requirements methodologies and wide range of health manpower to population ratios that can be derived as a result of these applications. This report is not intended to recommend a specific approach or method for use by health manpower planners or analysts, nor is it intended to provide a comprehensive, thorough description of all available approaches used to determine manpower requirements.

Conceptual Framework

As previously mentioned, many methodologies or approaches have been developed in order to estimate health manpower requirements and no guidelines or concensus exist concerning the most appropriate methodology. This lack of concensus reflects the differing opinions about health manpower concepts and definitions as well as the variety of factors influencing the demand for health care services. Even when planners agree on various factors that must be measured to evaluate health manpower requirements, opinions differ on the best way to measure those factors. Thus the development of health manpower requirements involves a large variety of policy decisions before a methodology can be chosen. The selection of methodologies and variables that contribute to the estimation of health manpower requirements is often contingent upon the manner in which the manpower problem is defined (DeFriese and Barker, 1983). Once the methodology is chosen the best way to apply it and measure pertinent variables is even more unclear.

The studies presented in this report have been grouped into the following four categories according to the type of methodology on which they are based: (1) medical need-based; (2) demand/productivity-based; (3) professional judgement-based; and (4) HMO-based. A description of these categories and their advantages and disadvantages are provided in Chapte 2 of this report. Although the health manpower-to-population ratio also is frequently used to estimate requirements for health manpower, abstracts of studies selected for this report exclude those which derive requirements estimates by simply applying a specified ratio to the population of a targeted area for a particular year. The ratio method has simple data requirements, has an application that is low in cost, and is relatively simple and easy to understand. Yet this method has a number of limitations that the users should be aware. Since population is the basis of this method it assumes that population size alone defines health manpower requirements and ignores other important influences that do not necessarily operate through population size. Population density, the organization of the health delivery system, medical technology, the funds available to compensate for health services, and the productivity of health manpower are

several variables that the ratio ignores that also influence health manpower requirements. The users of this method must assume explicitly or implicitly that the choice of the ratio itself implies that these overlooked variables operate in his situation in the same manner that they operate in the situation that the ratio was selected (Kriesberg, 1976A).

Organization of this Report

Chapter 2 of this document details the methodological approach used in this study to identify and compile relevant health manpower studies, the criteria developed to analyze the studies, the classification scheme used and assumptions identified in the methodological approaches. Chapter 3 presents a discussion of the relevant health manpower/population requirements ratios identified and derived through this study. An evaluation of the clustered ratios that detals further possible reasons for the observed variations among these ratios as well as their strengths and weaknesses and potential uses by health planners is also presented. The ratio tables included in this chapter are presented for illustrative purposes to demonstrate the range and variety of the ratios presented in or derived from information in the literature. Chapter 4 presents abstracts of the selected health manpower requirements studies that have been primarily evaluated according to their methodology and application. These abstracts should be viewed as explanatory documentation of the ratios presented in Chapter 3. They detail relevant bibliographic information, the health fields of concern, the purpose, methodology, and underlying factors and assumptions presented in the studies. The purpose and use of the bibliographies and appendices are presented within the context of the appropriate chapters.

CHAPTER 2

METHODOLOGICAL APPROACH TO THE COMPILATION OF HEALTH MANPOWER REQUIREMENTS STUDIES

Identification of Studies Concerning Health Manpower Requirements Standards

In the search for relevant health manpower requirements studies, on-line computer-based literature searches were conducted. Over 1,500 document abstracts were identified that related to health manpower requirements for the health fields of concern. However, all of the 1,500 studies were not retrieved and analyzed. Abstracts of these studies were reviewed and if the studies appeared to be relevant then they were subsequently obtained and analyzed. Manual literature searches also were conducted and relevant studies obtained and analyzed. Letters requesting citations or copies of recent state manpower requirements studies and/or the most recent health manpower component of state health plans were sent to 130 HSAs and 57 SHPDAs. Those agencies that responded did so in a comprehensive manner, often sending hard copies of relevant reports. All of these studies were analyzed for possible inclusion in this report. Letters requesting citations to or copies of recent health manpower requirements studies also were sent to over 100 health/medicine organizations that were thought to have knowledge of manpower requirements studies for the health professions of concern. All identified documents were analyzed for inclusion in this report.

Criteria for Analyzing Identified Health Manpower Requirements Studies

Criteria for analyzing identified health manpower requirements studies were developed according to established study parameters. Those studies meeting the set criteria were abstracted and included in this report (See Chapter 4). Health manpower requirements ratios were obtained or developed from these studies and included in summary ratio tables (See Chapter 3). The remainder of this section presents the criteria developed to analyze manpower requirements studies according to health profession, methodology, and application. Appendix A provides complete bibliographic information on the abstracted studies. Although the literature was surveyed for manpower requirements studies on all health occupations, studies on six major health professions were found to be relevant to the purposes of this project and are included in this report: medicine (including medical doctors and doctors of osteopathy), dentistry, optometry, pharmacy, podiatry and nursing. Figure 2-1 presents a comprehensive list of health professions including specialties and subspecialties that are included in this report.

Figure 2-1. Health Fields for Which Articles Were Abstracted

Medicine (MDs and DOs)
- Aerospace Medicine
- Allergy and Immunology
- Anesthesiology
- Cardiology
- Child Psychiatry
- Colon and Rectal Surgery
- Dermatology
- Emergency Medicine
- Endocrinology
- Gastroenterology
- General/Family Practice
- Gynecology
- Hermatology/Oncology
- Infectious Diseases
- Internal Medicine
- Neonatality
- Neoplastic Diseases
- Nephrology
- Neurology
- Neurosurgery
- Nuclear Medicine
- Non-Care Specialties
- Obstetrics
- Occupational Medicine
- Ophthalmology
- Orthopedica Surgery
- Otolaryngology
- Pathology
- Pediatric Allergy
- Pediatric Cardiology
- Pediatric Endocrinology
- Pediatric Hematology/Oncology
- Pediatric Nephrology
- Pediatric Neurology
- Pediatric Psychology
- Pediatric Surgery
- Pediatrics (General)
- Plastic Surgery
- Preventive Medicine
- Psychiatry (General)
- Psysiatry (Physical Medicine and Rehabilitiation)
- Public Health (Medicine)
- Pulmonary Diseases
- Radiology
- Rheumatology
- Secondary Care
- Secondary Specialties
- Surgery

Figure 2-1 (Continued)

- Surgical Specialties
  - Thoracic Surgery
  - Urology
  - Vascular Surgery
- Dentistry
  - Endodontology
  - Oral Pathology
  - Oral Surgery
  - Orthodontology
  - Pedodontology
  - Periodontology
  - Prosthodontology
- Optometry
- Pharmacy
- Podiatry
- Veterinary Medicine

Methodology. Another major criterion for analyzing manpower requirements studies was the methodological approach developed and/or applied. Documents that simply discussed health manpower requirements methodologies were excluded from the abstracts but are listed in Appendix B. A methodology for estimating health manpower requirements had to be presented within the context of a study in order to be included in this report. Studies that simply presented health manpower requirements estimates or standards without referencing or discussing the methodology on which the estimates were based were not included in this report.

A number of studies found through the literature searches simply applied to a specific population national supply averages or estimates derived from other studies. These studies were eliminated from this report. In the case where estimates used were derived in other studies, the original study was obtained and abstracted. Studies simply applying national manpower averages or geographical manpower averages tend to be misleading and overly simplistic and were therefore eliminated from this report. Studies were excluded from this report that developed standards for relatively small or atypical geographical areas or population groups that were believed to have limited applicability.

Application. Studies that simply developed or described health manpower requirements methodologies and did not develop numerical health manpower requirement estimates were not included in this report. Study methodologies had to be "applied" in the sense that hard data had to be input into the methodology or model to develop actual health manpower requirements numbers for the study to be included in this report.

Date of Study. Studies published during or since 1976 were the primary focus of this report. Most studies cited in the 1976 report that had been updated by more recent studies were excluded from this report.

Summary of the Reasons for Excluding Studies

The amount of health manpower "needed" or "required" to provide health services to a particular population can either refer to the number that should exist, or to the number needed to close the gap between a target level and a projected supply. The studies of interest within the scope of this report were those identifying health manpower requirements in the former sense, specifically, those that attempted to prescribe a "most appropriate" or "adequate" supply of health manpower. Strictly methodological studies, dated studies, and descriptive studies of supply projections did not appear to be relevant for the forementioned purpose. Selected expressions of existing ratios, such as those observed in HMO settings in addition to normative judgements and empirical calculations as to what health manpower availability "should be", have been analyzed and included in this report.

The reasons for excluding health manpower studies as not meeting the established criteria were categorized as follows:

A. Foreign Study (Non-U.S. Study)
B. General discussion;
C. Irrelevant health manpower category addressed;
D. Methodology discussion only;
E. Methodology unclear;
F. Ratio or standard from other sources;
G. Manpower requirements considered, but no estimates derived;
H. Study has been updated by more recent report/dated study;
I. Supply estimates and projection only;
J. Additional manpower needed estimated but no presentation of original manpower supply; and
K. Study included in another report.

Appendix B presents a table of the studies which were reviewed but excluded from this report and the reasons for their exclusion.

Methodology Classification Scheme

The studies that met the established criteria were re-evaluated, clustered according to the appropriate occupation and methodology categories and abstracted for inclusion in this report.

The estimates of health manpower requirements identified and analyzed within this report were based on a wide variety of methodological approaches and assumptions. These studies were grouped according to the methodological approach that served as the basis for the estimates they provided. The following discussion presents the four groupings or clusters of the classification scheme used, along with a discussion of the advantages and disadvantages of each of these methods. Table 3-1 shows the studies abstracted in this reported grouped according to the methodology used.

The Health (or Medical) Needs Approach

Description. The health needs approach is based on the concept of the amount of health care that should be consumed by the public in order to maintain a healthy population. A standard of health care needed by a specific population is determined from expert opinion, data analysis, or from a combination of professional opinion and empirical data. The amounts and quality of services required to maintain a healthy population are based on information such as health status (incidence and prevalence of particular disease conditions), medical knowledge, and available technology. Services needed are then converted to the number of health professionals required by means of productivity standards or estimates. For projection purposes, health needs are estimated according to assumptions about the future.

Advantages. The appeal of this approach is that it focuses on the health status of a population and the manpower required to attain or maintain "good" health. The concept of optimal health prevalent in this method complements the development of goals and objectives activities of local health planning agencies. This method can produce a clear picture of what "ought to be" the state of the health care system.

Disadvantages. A major disadvantage of this method is the extensive amount of data required to apply it effectively. A great deal of the information required may not be available at a state or local level and may be very costly to either compile or obtain. The definition of health needs also is difficult to assess because of varying opinions of experts. Another limitation of this method is that it does not consider the demand for or the ability to obtain health care thus eliminating such influences as consumer tastes and preferences, the ability of the consumer to pay for health care services, and other financial and social barriers to seeking health care. Therefore, health care standards based on the concept of need often overestimate the use of health care services.

Professional Judgement-Based Approach

Description. Professional judgement or expert opinion can be used in a variety of ways related to the estimation of health manpower requirements. The use of professional judgement may be the sole determinant of specific manpower requirements such as when experts or professionals are consulted to determine health manpower to population ratios. Professional judgement may also be used as part of a methodology that employs empirical methods. Experts are also asked to determine the health care needs of a population or to project future demand. Experts and professionals also estimate utilization rates and productivity rates for various services in different settings. The opinion of experts and professionals can be elicited by a number of methods. The Delphi technique, which involves a series of questionnaires, is a very popular method to elicit opinions. Other methods involve discussion sessions to evaluate various assumptions and opinions. This method often involves reaching a consensus on which the derivation of health manpower requirements then is based.

Advantages. Expert and/or professional opinion is helpful when data sources are inadequate or unavailable. Expert opinion on productivity rates, task delegation, or the role of the health professional may make the resulting health manpower requirements more "realistic".

Disadvantages. There are many inherent limitations in methodologies that rely on professional or expert opinion: (1) reaching a consensus on the variable in question is a difficult task; (2) a great number of biases are often introduced; and (3) unstated assumptions often influence individual opinion. Experts/professionals may overestimate the health needs of

specific populations. When considering the productivity of health professionals, such variables as task delegation or the perceived role of a health professional may influence the productivity estimations made by the expert. When experts/professionals are used to determine health manpower to population ratios, the criteria used to derive these ratios are often unclear or unknown. It is also possible that the experts/professionals polled have little knowledge of the area of interest or insufficient data to base his judgement. Also, whether one uses the mean or median of the judgement or the Delphi technique to reach a conclusive manpower to population ratio can alter this figure significantly (Solberg, 1976).

Demand/Productivity-Based Approaches

Description. There are several methods used to estimate or project the demand for health manpower:

- The budgeted vacancies (or employer survey) approach. This approach involves a survey of health manpower employers to obtain information concerning the number of open positions available and/or the anticipated personnel needed for a target year. The present unmet need for health manpower is represented by the current unfilled budgeted positions. Future requirements are represented by employer opinion concerning anticipated vacancies and need.

- Using present utilization rates as a proxy for demand while varying the size and demographic characteristics of the population. Utilization of services and manpower is sometimes used as a proxy for "effective" demand, although the two differ according to the amount of unfilled demand that is not directly measurable (DHEW, 1976). The patterns of health care utilization of a specific population, which is categorized according to population demographics such as age and sex, are analyzed assuming that health services utilization indicates the willingness and ability of consumers to pay for health care. Forecasts of health manpower requirements can be determined by projecting future utilization rates according to sub-population projections and matching these rates against manpower productivity.

- Using utilization rates as a proxy for demand while varying size and demographic characteristics of the population and income levels. This method is similar to the previous method described above but assumes that income level as well as age and sex affect the demand for health care services.

- Economic (Effective) Demand Approach. This methodology focuses on the "effective" demand for health care; the willingness and ability of consumers or the community to pay for health services as the primary determinant of the demand for health manpower (DHEW, 1976). This approach offers more fully specified models of utilization that provide for economic incentives and thus remedy some of

the deficiencies of the simple demographic models discussed previously. These models incorporate the realities of scarcity and economic choice as they affect utilization. By specifying relative prices of various forms of care, these models can account for economic incentive to substitute one type of care for another (DHEW, March 1978). Health manpower requirements estimates are derived from an estimate of the funds available to finance health care or from an estimate of the services consumers are willing to pay for while taking into account the productivity of health professionals and the tasks they perform. Effective demand for health manpower may be determined by surveying health manpower employers or by analytical deduction from health expenditures or service utilization data (DHEW, 1976).

- o Economy-Based Methods. This method determines the demand for health manpower by observing the general structure of the entire economy rather than the specific facets of the health care industry. While other demand models forecast by projecting trends in utilization or projecting presentation utilization patterns, this method predicts demand by utilizing expected levels of economic activity and trends in technological linkages between sectors in the economy (DHEW, 1978).

- o Econometric Techniques. These models tend to be grounded firmly in economic theory and in essence contain two components. The first component incorporates the supply of health manpower while the other addresses demand or requirements. The models often assume that particular variables are critical components of the health economic system (Born, 1981).

Advantages. The budgeted vacancies approach is considered advantageous in that: (1) information is gathered from persons who should be the best informed about how many persons will be hired; (2) it is relatively simple; and (3) it is inexpensive. Also, since it is related to job opportunities it can prevent an overstatement of health manpower requirements. Utilization-based approaches are advantageous because that they take financial variables into account. In addition, utilization-based approaches allow health planners to choose utilization data geared to specific demographic and health status characteristics of a particular area. Since some techniques incorporate current utilization data, then the basic patterns of utilization and manpower productivity are achievable. Economic models allow planners to obtain answers to particular health manpower research hypotheses concerning such issues as the impact of Health Maintenance Organizations (HMO) on the health care delivery system. Economy-based techniques allow for the consideration of economic influences other than those of the health care delivery system itself. The basis for this method is a complex and comprehensive set of economic and technological projections (DHEW, 1978) and thus has great value in serving as an independent check on other demand forecasts. Econometric techniques can provide valuable information on how aggregated variables of a specific health care system interact. Econometric models can also provide a great deal of informa-

tion on the patients, providers, and organization of a specific health care system.

Disadvantages. The major disadvantage of demand-based methodologies is that they do not consider the health care needs of a population. In addition, those that use current or present utilization rates as a measure of demand often do not consider the possible changes in other economic variables such as third-party payers, health care costs, or accessibility that may also influence the demand for health care. Often the specification of demand models complements the testing of specific research questions concerning utilization rather than determining health manpower requirements consistent with those utilization patterns. Therefore, most models are incomplete and have to be adapted before manpower requirements can be considered (DHEW 1978). The budgeted vacancy approach produces health manpower estimates from the perspective of existing institutions and does not effectively consider new organizations that may be developed or the unstated assumptions when making projections into the future. Also, being institutional-based, it does not provide for a survey of solo or self-employed practitioners. It is also subject to sampling or response error. Most of the demand-based methodologies require a great deal of data or information, technical expertise, and financial resources.

Prepaid Group Practice Approach

Description. Health manpower requirements also can be estimated by studying the practice patterns of comprehensive prepaid group practices such as Health Maintenance Organizations (HMOs). These practices are studied on the assumption that they operate more efficiently than other health care delivery organizations and they truly provide health, rather than medical services, through their inclusion of disease prevention and health promotion services. The variables primarily analyzed are the number of health personnel required to provide care to the enrolled population and the percentage of providers in primary and secondary health care services. These findings are often expressed as either the median manpower/population ratio among several practices or the "optimal" manpower/population ratio. Task delegation and the roles of health professionals are also observed to evaluate their impact on manpower productivity.

Advantages. The major advantage of this method is that data are generally available. Also, health planners who obtain standards derived from settings that appear to be more efficient may want to recommend changes that may increase the efficiency of their health care system.

Disadvantages. Prepaid group practice enrollee populations may not display characteristics similar to those of the general population. They can not often be considered representative samples. Prepaid group practice members tend to have a higher level of education, income, and health than

the national population. The number, distribution, and mix of health care providers in these organizations are determined by each specific organization and do not often correspond to that of other health care systems. In addition, each specific prepaid group plan is unique in terms of the comprehensiveness of care. Members often seek care outside of their organization, thus reducing the number of providers required to service enrollee population. Health planners should recognize to these dissimilarities when utilizing this method.

Underlying Factors and Assumptions Categorization

When estimating health manpower requirements, the methodologies used often incorporate unique underlying factors and/or assumptions that directly or indirectly affect the estimates produced. For each study selected, the underlying factors and/or assumptions inherent to the methodological approach were coded according to a system orginally devised in the 1976 report. The purpose of this coding system is to summarize the various factors and assumptions considered in the development of each estimate. This coding system has been slightly revised and expanded to meet the needs of this present report. Letters were assigned to morbidity/demand-related, supply/productivity-related, delivery system-related, and other factors as listed below. Numbers were assigned to the type of evidence that was utilized in quantifying or describing each factor or assumption. The selected abstracts presented in Chapter Four or the original studies themselves should be referred to for a more comprehensive understanding of the ratios. The underlying factors/assumptions and their codes are as follows:

Morbidity/Demand-Related Factors

A. Prevalence/Incidence of Disease Conditions
B. Consideration of Selected Disease Conditions
C. Backlog of Untreated Conditions
D. Requirements for Preventive Care
E. Quality of Care
F. Changing Definitions of Health
G. Utilization Rates

Supply/Productivity-Related Factors

H. Time Required to Produce Services or Visits
I. Case Loads Per Health Professional
J. Technological Advances
K. Task Delegation

Delivery System-Related Factors

L. Organization

M. Setting
N. Role Definition of Health Professionals (e.g., primary and specialty care functions)

Other Factors

O. Patient Subpopulations
P. Reimbursement Mechanism
Q. Ability to Pay
R. Health Insurance Cost Savings
S. Full-time Equivalent Standard
T. Household/Individual Demographics
U. Health Professional Practice Patterns
V. HMO Staffing Patterns
W. Type of Care
X. Geographics Location (e.g., urban, rural, state, etc.)
Y. Physician Density
Z. Number of Hospital Beds Per Population

Type of Evidence on Factors

1. Observations of Actual Conditions
2. Test of Survey Results
3. Single Source Judgement
4. Unclear

These underlying factors/assumptions can be useful when assessing the relative value of requirements methodologies and ratios for a particular purpose. Estimates based upon observations of actual conditions (evidence factor 1) may be found to be the most valuable. Estimates incorporating factors based on test or survey results (evidence factor 2) can also be valuable to the user. Estimates derived from studies in which a great deal of "single source judgement" evidence (evidence factor 3) is used may be less useful. Estimates incorporating factors based on unclear evidence (evidence factor 4) should be used with extreme caution. Overall, the most important issue is that the user of any health manpower requirements ratio should use it cautiously. Careful consideration should be given to those estimates with specific factors most directly related to the purpose that the ratio will be utilized.

Conversion of Numbers Derived in Studies to Requirements Ratios

Many selected studies estimated health manpower requirements as the number of individuals needed. In these cases the "numbers needed" were converted to ratios of health professionals per 100,000 population. The U.S. Census Bureau figures used to derive these ratios are presented in Figure 2-2. Population estimates for 1970-1979 were taken from Current Population Reports, Series P-25, Number 917 (July 1 population). Population estimates for 1980-1984 were taken from Current Population Reports,

Figure 2-2. U.S. Population Estimates and Projections Including Armed Services Abroad

Year	Population (000)	Year	Population (000)
1970	205,052	1991	251,767
1971	207,661	1992	253,817
1972	209,896	1993	255,800
1973	211,909	1994	257,714
1974	213,854	1995	259,559
1975	215,973	1996	261,339
1976	218,035	1997	263,060
1977	220,239	1998	264,731
1978	222,585	1999	266,360
1979	225,055	2000	267,955
1980	227,738	2001	269,524
1981	230,043	2002	271,074
1982	232,345	2003	272,612
1983	234,538	2004	274,144
1984	236,681	2005	275,677
1985	238,631	2006	277,206
1986	240,856	2007	278,725
1987	243,084	2008	280,238
1988	245,302	2009	281,743
1989	247,498	2010	283,238
1990	249,657		

Series P-25, Number 965 (July 1 population). Population projection estimates for 1985-2010 were taken from current Population Reports, Series P-25, Number 952. Part B, Series 14, Middle Series was used, which assumes an ultimate cohort fertility of 1.9 births per woman. It should be noted that when population estimates and/or projections were presented in the studies, an effort was made to use those numbers presented.

The ratios derived from the data provided in the abstracted studies are grouped according to the four methodology categories previously discussed and are shown in Summary Tables 3-2 and 3-3.

Evaluating Health Manpower Requirements Ratios

When evaluating health manpower requirements ratios the user must keep many important factors in mind. Each ratio is usually based on a unique set of empirical data and underlying factors/assumptions. The same original primary data sources and methodology can be used to derive a ratio, but different ratios can be produced because of unique underlying factors/assumptions, the unique definitions of concepts, and specific data manipulations by the researchers. The user should pay particular attention to the differences between health manpower factors related to his target geographical or health service area and the factors on which the estimate being considered was based. Areas may have different population densities, population demographic mixes such as age, race and sex distributions, income levels and morbidity patterns. Health care delivery patterns, the degree and type of health insurance coverage and health facilities and institutions are important factors that may also differ among areas. A totally acceptable standard that may be applicable in one area, may not be applicable in another.

Health manpower supply mixes in an area may also be a determinant of the most useful ratio to apply. The degree of health manpower substitutability and task delegation possible in an area can greately impact the choice of a ratio standard. One area may have a greater number of ophthalmologists than opticians or optometrists. Therefore, the requirement for ophthalmologists in this area may be higher than that of an area more amply supplied with opticians and/or optometrists.

The degree to which members of the population are enrolled in HMOs should also be considered. A ratio based upon the experience of a area where a significant portion of health care is provided by HMOs, may not easily be transferable to an area where the majority of health care is provided by fee-for-service physicians.

The data of the health manpower study developing these ratios must also be considered as well as the date of the empircal data sources used to develop the ratio or estimate. Ratios using the most recent primary data sources may be more useful to health planners depending on the health manpower-related factors existing in the target area of concern.

CHAPTER 3

DISCUSSION OF OBSERVED HEALTH MANPOWER REQUIREMENTS RATIOS

Introduction

The manpower/population ratio method, which is very frequently noted in the literature, involves a comparison of an area's present manpower/population ratio with an average or standard ratio. However, confusion may result because manpower/population ratios are also used to express the findings of other methods that incorporate elaborate estimates or calculations of ideal values based on assumptions about the need and/or demand for health services. (DHEW, 1979, pp. 44, 48)

Normative judgements and empirical calculations as to what health manpower availability "should be" in addition to ratios such as those observed in HMO settings have been analyzed and are presented in the ratio summary tables included in this chapter. It should be re-emphasized at this point that the health manpower/population requirement ratios presented in this should not be interpreted as the "most appropriate" or an "approved" single set of requirements standards for direct, uncritical application or use by health planners. The set of requirements ratios that are shown in Table 3-2 and 3-3 should be viewed as a listing of health manpower/population requirement ratios that resulted from a comprehensive criteria-based summary of health manpower requirements studies.

It should be clear from the detailed discussion and tables that follow that no single ratio is entirely compatible and consistent with any other. Yet each of the ratios presented can provide valuable information for comparative and analytical purposes. Various issues associated with each estimate such as the methodology employed, the underlying factors/assumptions, and the date of the study should be considered. The abstracts presented in Chapter Four include this information and should be reviewed when evaluating various requirements estimates.

The ratio summary tables that follow and their associated abstracts should permit health planners and health manpower analysts to focus on those studies that are of particular interest, rather than initiating a difficult and time-consuming inventory and evaluation of studies. The summary tables should be viewed as a beginning for further effort rather than an end-product. The final responsibility for the use of any of these ratios must remain with the user.

General Observations

Although there was a great deal of literature on health manpower issues, the majority of the literature contained strategies and recommendations for reducing the threat of current and future manpower surpluses. There were also many studies that addressed manpower distribution, supply and related concerns, such as strategies for recruiting health manpower for a specific area, health manpower training, and admissions control strategies for U.S. medical schools. Several studies that addressed health manpower "needs" and "requirements" failed to define the specific critieria for identifying appropriate limits or "cut-off points" for manpower supplies. Many studies address the "need" or "requirements" for health care services without converting to the "need" or "requirements" for health manpower. Often, manpower requirements were specified, but no justification was presented. The state documents reviewed frequently presented manpower requirements, but only cited other previous state studies for the methodology and derivation of these requirements. These original studies were difficult to obtain. Some agencies explained that no resources were available to update state health manpower requirements information and therefore dated studies were used in their preparation of the state health plans.

Many local health planners employed national requirements as standards for the assessment of health manpower requirements for their specific areas. Health manpower shortage area criteria developed by the Department of Health and Human Services (DHHS) were often used by states. However, many states either identified these shortage areas on a map and did not present specific manpower requirements or specified the additional number of health personnel needed to alleviate shortages without presenting the current supply. Several studies from the state of Rhode Island presented a comprehensive assessment of the health manpower requirements for the state by using a number of methodologies developed in other published studies. A number of state studies reviewed used GMENAC estimates as standards to determine the number of health professionals required. In these cases, the GMENAC estimated number of health manpower required for given specialties was divided by the U.S. projected population for 1990 to derive health manpower to population ratios. These ratios were then applied to their state manpower supply and populations to determine the amount of additional manpower required to meet these GMENAC ratios. It appears that more local planners are using standards derived from other studies to assess their health manpower requirements rather than simply adopting the average supply ratio (or the ratio of a neighboring state, the highest census region, or the "all-time high", etc.) as was reported in the previous 1976 study.

There are many reports that provide surveys of health manpower requirements models and methodologies, discussions of factors that influence the demand for health manpower, or discussions of the problems or issues related to forecasting and estimating health manpower requirements. They present a wide variety of methods that can be used to estimate health manpower requirements, the limitations and advantages of these methods, and the demand factors.

However, considering the great number of documents reviewed, relatively few studies actually derive numerical population-based health manpower requirements estimates. In general, estimated requirements for each health profession group, particularly the medical specialties, vary widely. This is expected considering the various methodological approaches, underlying factors/assumptions, dates of studies, and data sources that can influence the derived estimates.

The majority of the selected national studies employ medical need-based and demand/productivity-based methodologies, while the majority of the state studies selected employ demand/productivity-based methodologies. As table 3-1 shows, very few recent studies are HMO-based methodologies. This does not necessarily mean that HMO data are not being utilized to estimate health manpower requirements. Some essentially demand/productivity-based methodologies such as the Health Professions Requirements Model of the Bureau of Heath Professions of the Department of Health and Human Services incorporate HMO data into their models in order to estimate health manpower requirements.

The type of approaches used for determining national and state health manpower requirements exhibit an interesting pattern. The few national and state studies addressing dentistry manpower all used demand/productivity-based methodologies to estimate dental manpower requirements. The medical need-based methodology was primarily used to estimate the requirements for physician specialties and to estimate manpower requirements for optometry and podiatry.

Despite the weaknesses and limitations of health manpower requirements methodologies, they can be useful and informative when applied in the most appropriate context or situation and when applied with their limitations in mind.

The following sections briefly describe the national and state studies included in each methodology cluster. These sections are followed by two ratio tables. The first table presents the range of selected requirements ratios by health profession group. The second ratio table presents the requirements ratios for each health profession group according to the specific study. Each ratio cluster has unique characteristics and applications that should be considered for evaluating its potential usefulness when applied to a particular geographical area or when used to meet a specific objective.

The Medical Need-Based Ratio Cluster

These ratios can be interpreted as "ideal" ratios. They essentially represent the maximum or "ideal" number of health professionals that would

be needed to serve the population of a target area if all health care conditions needing treatment were actually treated. Since these estimates are based on "ideal" conditions, they tend to overestimate the actual demand or perceived need for care. The medical need-based manpower ratios shown in the ratio tables tend to be higher than those of other methodologies as expected.

The 1933 Lee and Jones study is the classic medical need-based study. Of the more recent studies, the Schonfeld study as well as the Roddy, Reinecke and the American Optometric Association studies are good examples of medical need-based studies that incorporate the ideology of Lee and Jones. Generally for the ideal studies of this type, incidence and prevalance data for a wide range of primary care conditions are gathered. Preventive care is considered for the newborn as well as well-child care. Treatment requirements are categorized according to the age of the population and the general nature of the problem (i.e., acute or chronic). Quality of care is dealt with by obtaining estimates from medical professionals/experts on the time required to produce high quality treatment. Then, manpower requirements are calculated for specific age groups and for acute, chronic and preventive care needs as well as for all me ical needs and for the total population addressed.

The Ravetch and Barton study initially attempts to assess pediatric surgery manpower requirements based on a medical needs approach but unfortunately this initial goal is abandoned and a final assessment made only on the adequacy of a projected supply.

The Graduate Medical Education National Advisory Committee (GMENAC) study presents an adjusted medical needs-based approach. This study attempted to make the medical needs-based approach more realistic by utilizing demand/productivity data and professional judgement in the form of Delphi Panels as well as data on the incidence and prevalence of disease conditions. This study was very controversial in nature because not only did it project health manpower requirements for 1990, but is also made projections concerning health manpower supply for 1990. The Committee then made recommendations based on the surpluses and shortages for specific manpower specialties for the year 1990. The literature critiquing this report is voluminous and will not be discussed here. However, it should be noted that one of the objectives of this study which it obviously achieved was to stimulate research and issues in the area of health manpower supply and requirements.

Only two state studies were identified that address health manpower requirements based on the medical needs approach. This is easily understood considering the voluminous amount of information that is required in order to effectively implement this approach.

The medical needs-based approach has several advantages that should again be noted. First, this approach is a disaggregate approach in that it explicitly presents the incidence/prevalence data and productivity data on which it is based. Therefore it can be a highly flexible methodology. Specific components of the method can thus be challenged, refined, or replaced with other data. Also, alternative estimates can be derived for different data or assumptions. For example, different productivity data can be used or data for specific disease conditions could be either updated with more current information or data concerning another disease condition could be used to replace it. The methodology is further flexible in that estimates fortreating one disease condition or any aggregate of problems could be derived, and professional/expert judgement on specific variables/ factors with empirical evidence can be integrated. The medical needs-based approach provides relatively objective and reliable estimates of health manpower requirements that correspond to specific stated assumptions because this approach is essentially empirical with regard to incidence/ prevalence data and often productivity data.

Based on the previously mentioned features, a major advantage of the medical needs-based approach is that manpower requirements can be derived and analyzed for meeting a wide variety of medical care needs. Health manpower resource expenditures for various medical care programs and savings from specific disease control programs can be explicitly addressed when setting health care planning priorities.

However, several limitations to the medical needs-based approach should also be noted. Overall, one should be aware that health care service needs, demands, and utilization are not often equivalent. It would not be efficient or effective to adopt health manpower policies that function around a goal that incorporates meeting all treatment needs when health care services in reality are provided in response to effective demand. If certain financial constraints, such as out-of-pocket consumer costs, are reduced in obtaining medical treatment, then the demand for health care services would more than likely move closer to that of services needed. A major flaw of this approach is based on the unstated assumption that health care consumer preference or desire for medical treatment coincides with the health manpower researcher or professional view of the optimal treatment regime.

Even if health care costs were reduced to a more acceptable consumer level, consumers may not seek care to the extent that health researchers or professional believe that it should be sought. There are many more important influences on health care utilization apart from the adequacy of health manpower supply. The medical needs-based approach may not provide the most useful standard for health care planning decisions based on this inherent limitation.

Another limitation of this approach is that many opportunities for utilizing empirical data are not often fully taken advantage of. Productivity data, as well as incidence/prevalence of disease conditions data, can be based on empirical data rather than professional judgement. Planners should note the extent to which medical needs-based studies incorporate empirical data. Task delegation and substituability assumptions and protocols should also be noted.

The Demand/Productivity-Based Ratio Cluster

A number of the selected health manpower studies estimate health manpower requirements from empirical data on utilization and productivity. These studies are derived from the fundamental demand/productivity investigations that use the following formula to calculate health manpower requirements:

$$Rt = (Dt/Qt)Pt \qquad (1)$$

where Rt is the number of health professionals demanded at time t; Dt represents per capita utilization of services, Qt is the resource requirement for a specific manpower type to produce one unit of service; and Pt is the population at time t. Methodologies vary in the type and number of factors incorporated into the projections per capita utilization of services (Dt) and the resource requirement (Qt), and in the way these factors are treated. Utilization is often projected by age and sex categories while assuming constant utilization rates within categories. Expectations of increased health care utilization such as the potential impact of national health insurance or increased HMO enrollment are often incorporated into these estimates. Productivity is frequently estimated as average observed case loads. Alternate requirements estimates are often produced by assuming various modes of task delegation or other factors that increase productivity such as increasing average hours of a work week.

Ratios based on this methodology, to some extent, may be the "best" ratios for many users, but these ratios should also be used with caution. Explicit consideration should be given to specific assumptions made about the following health factors: manpower productivity, health services demanded, the use of factors concerning technology, proportion of the population covered by health insurance, task delegation, and manpower substitutability.

The Bureau of Health Professions (BHPr) of the DHHS has developed a very comprehensive utilization-based model for assessing health manpower requirements and is probably the most detailed study of this type identified. The U.S. population is categorized according to 40 subgroups by age, sex, and family income. Per capita utilization rates are calculated according to 20 forms of care, including nonpatient care, and six types of settings. Matrices were developed that account for the various types of

care a given health practitioner can provide. Utilization growth factors are calculated in order to derive health manpower requirements for future years. Trend adjustments were made that factor the effects of price of health care services and health care insurance coverage out of each utilization trend. Nonprice trend adjusments are made to account for such factors as medical technology and the incidence of disease. Contingency components have been incorporated to examine health care policy issues such as National Health Insurance, HMO growth rates, and potential increases in task delegation.

The Rodowskas studies are unique in this demand/productivity category in that pharmacy manpower requirements are estimated and projected based on projected growth in drug expenditures rather than directly from population growth or manpower-type utilization factors.

It should be noted that these methodologies require extensive data. They incorporate data on the population of an area by demographic characteristics, manpower requirements by type of care (in-patient, out-patient, etc.), and information on the utilization of services by demographic characteristics of the population and by type of care. However, where local data are nonexistent or inaccessible for the utilization of services, national data on physician and dental care visits can be obtained from national surveys such as surveys from the National Center for Health Statistics.

The strengths of the demand/productivity-based methodologies are similar to those discussed for the medical needs-based methodologies. Both of these approaches are essentially empirical in nature and allow for the integration of both empirical and judgemental data. They are also disaggregative and therefore flexible in that they are capable of generating alternate requirements estimates for various assumptions. In addition to this, some parameters can be fixed while varying other related factors and vice versa. For example, a specific manpower supply can be fixed while observing the effects of this on various productivity scenarios such as substitutability and task delegation.

Another advantage of demand/productivity-based ratios is that they reflect anticipated demand for and utilization of health care services. They are not as "idealized" as medical needs-based ratios. Therefore demand/productivity-based methodologies tend to present a more realistic estimate on which to base health manpower planning. However, the user should note the relative reliability of these ratios that depends on the specific factors considered that may influence the demand for health care, the way in which these factors are considered and, foremost, the reliability of the empirical base. Some studies are very simplistic in that they assume constant utilization rates and productivity. Others incorporate special assumptions about the impact of task delegation, technological advances, the growth of HMOs or national health insurance. These assump-

tions and factors should be noted cautiously. Overall, in view of the uncertainty of future events, one of the most valuable uses of the demand/productivity-based approach would be the development of a range of alternate manpower requirements corresponding to different assumptions based on the present state of the health care system.

The majority of the weaknesses found in the demand/productivity-based approach stem from the failure of these studies to fully utilize the potential of the methodology for generating a valuable range of estimates. A greater use of empirical data for productivity and productivity changes has been shown to be beneficial at this time whereas earlier studies did not fully exploit this advantage. The quality of health care could be effectively considered here.

The Professional Judgement—Based Ratio Cluster

Overall, health manpower studies seem to be moving away from the development of professional judgement-based ratios. The majority of the studies falling within this category were written prior to 1976. For a more detailed discussion of these studies, see the previous 1976 report.

Prescriptions for health manpower requirements based on professional judgement vary according to the type of input. The input may be from one expert's opinion or a survey of professional opinion or an "opinion" based on existing health manpower resources, trends, and expectations. The professional judgement-based ratios presented here are all aggregate expressions in the sense that no assumptions about services delivered, utilization rates, productivity, etc. are directly expressed with the exception of the Moore study, which uses a 5% increase in certification rate as its base. This is a major limitation of this approach. It is impossible to determine how realistic these estimates are with no knowledge of the factors on which these estimates were based.

Because these ratios are not empirically based, they may not be fully objective. They represent the opinion of the health care provider on what health manpower supply should be. There is little consideration in this approach for incorporating health care consumer tastes and preferences. Overall, this method allows great consideration of professional interests and personal and professional biases. Whether it is a single source judgement or a survey of professional opinion, implicit assumptions and biases exist.

Ratios based on this methodology can be very useful, but should be used with caution. Particular attention should be given to the appropriate source documents referenced. The user should note the specific assumptions that were taken into consideration by the professionals/experts, if any, in

developing the ratio and whether empirical data of any kind support the estimates. These ratios incorporate very different rationals for their development. For example, some ratios may be area-specific and only reflect the unique characteristics of a specific state or geographical area. Others may be developed with no direct justification or basis for the estimates produced. The user should evaluate these ratios carefully. An attempt should be made to fully understand the objective of the ratio estimate in order to evaluate them properly. An example of a ratio that should be closely scruitinized before use is "a judgemental ratio described as 'ideal' which may have little relationship to any pragmatic planning process taking place in an area (DHEW 1976)."

Recent studies appear to incorporate professional opinion into more empiricially-based approaches such as the medical needs-based approach and the demand/productivity-based approach rather than relying on professional opinion alone to estimate the adequacy of present and future health manpower resources.

The HMO-Based Ratio Cluster

These ratios reflect requirement patterns derived from prepaid, comprehensive group medical practice settings, such as HMOs, that are specific to particular areas, population groups, financing mechanisms and health delivery systems. These ratios are unlikely to be totally relevant in different situations.

Few recent studies incorporating the HMO-based methodology were identified. HMO data appear to be more recently incorporated into demand/productivity-based methodologies to generate alternative estimates of health manpower requirements. The HMO studies identified, however, vary in the extent they expand or utilize HMO data to determine health manpower requirements. A study by Mason presents the number of health professionals per the number of plan enrollees and optimum ratios reported by HMOs. Whereas the studies by Scitonsky and McCall, and Krasner and Ramsair, for example, extrapolate HMO health professional staffing patterns to the nation as a whole while accounting for population age and sex differences.

The variation in health manpower to population ratios derived by this approach may be due to several factors. Among HMOs there are differenes in enrollee characteristics, differences in the comprehensiveness of plan coverage, and indivisabilities or differences in health manpower role definitions. The latter problem of noncorresponding health professional role definitions can be particularly serious in the area of primary care. Some HMOs employ almost no family/general practitioners and assign primary care to internists and pediatricians while other HMOs substitute family/general practitioners for internists.

The weakness of this approach lies not with the derivation of the ratio themselves--they are simply observed manpower supplies in relation to patient populations--but in the assumption that the HMO setting provides appropriate indicators of manpower requirements for health manpower planning. This assumption can be questioned on several grounds.

First, the staffing pattern of any model HMO must necessarily be adjusted to be applicable to the general population. It is well known that HMO enrollees are a self-selected, atypical group of medical care consumers. They are generally younger, better educated, and more up-to-date in their health care, and thus present a different array of medical problems to the health care system than would the average patient population. Further adjustments would be necessary in cases where services are purchased outside the plan (some specialty services and long-term care for example), and additional estimates for non-patient care requirements would have to be added. The problem of role definition was mentioned above. The requirements estimates for general practitioners, internists, pediatricians and obstetricians/gynecologists derived from any particular HMO staffing pattern are appropriate only if their relative roles in that setting are also deemed appropriate.

Even if such adjustments were made, it is highly questionable whether these adjustment ratios would be relevant in a context other than prepaid group practice. Special incentives are created in the financially bound HMO system. Providers are induced to respond differently than in a fee-for-service system, both in terms of prescribed treatment regimen and manpower mix. The financial constraints of prepaid plans, therefore, have a fundamental impact on manpower requirements in the system, by shaping what services are produced and what mix of health workers produce them. A whole new set of problematic issues arises in considering the likelihood and feasibility of increasing the prevalence of HMO's, and even the relevance of currently observed HMO staffing patterns to what might be obtained under widespread coverage. Thus, unless it is envisioned that most health care will be delivered through an HMO type setting, these ratios are not very useful for health manpower planning.

TABLE 3-1

SELECTED STUDIES OF HEALTH MANPOWER REQUIREMENTS
BY METHODOLOGY CLUSTER

National Studies

Medical Need-Based

Ref. No.	Authors	Health Profession
2	American College of Radiology	Diagnostic and Therapeutic Radiology
3	American College of Radiology	Therapeutic Radiology
4	American Optometric Association	Optometry
5	American Podiatry Association (Demand/Productivity-Adjusted)	Podiatry
9	Bowman, et al (Demand/Productivity-Adjusted)	Anesthesiology, Neurology Nuclear Medicine, Pathology Physical Medicine and Rehabilitation, Radiology
11	Burnett, RD	Pediatrics
29	Ravitch	Pediatric Surgery
30	Reinecke, RD	Ophthalmology
32	Roddy, PC	Primary Care Medicine
36	Schonfeld	Primary Care Medicine
47	U.S. DHHS (Demand/Productivity-Adjusted)	All Medical Specialties
54	Yahr, MD	Neurology

Demand/Productivity-Based

Ref. No.	Authors	Health Profession
1	American Academy of Pediatrics	Neonatology
6	American Thoracic Society	Pulmonary Medicine
11	Burnett, RD	Pediatrics
13	Cole and Cohen	Dentistry
15	Dyken, M	Neurology (Indiana also)
21	Mathematica	Pharmacy, Veterinary Medicine, Foot Care, Vision Care
33	Rodowskas	Institutional Pharmacy
34	Rodowskas, CA	Pharmacy, Anesthetics
44	Trobe and Kilpatrick	Ophthalmology
45	U.S. DHHS	All Professions
46	U.S. DHHS	Medicine

Demand/Productivity-Based (Continued)

48	U.S. DHEW	Podiatry
49	U.S. DHEW	Primary Care Medicine, Dentistry, Psychiatry, Podiatry
50	U.S. DHEW	Dentistry
53	Williams, DC	Surgical Specialties

Professional Judgement-Based

Ref. No.	Authors	Health Profession
6	American Thoracic Society	Pulmonary Medicine
7	Anderson et al.	Pathology
8	Birchard and Elliott	Optometry
15	Dyken, ML	Neurology
18	Knowles, JH	Anesthesiology, Pathology, Radiology, Urology
22	Moore, FD (Adjusted Demand/Productivity)	Surgery, Internal Medicine, Anesthesiology, Pathology
26	O'Neill and Vander Zwagg	Pediatric Surgery
28	Paxton, HT	All Medical Specialties
33	Rodowskas and Dickson	Pharmacy
51	U.S. GAO	Allergy

HMO-Based

Ref. No.	Authors	Health Profession
19	Krasner and Ramsay	Dermatology
20	Mason, HR	Medicine
37	Scitovsky and McCall	Medicine

State Studies

Medical Need-Based

Ref. No.	Authors	Health Profession
17	Kansas Department of Health and Environment	Medicine

State Studies

Medical Need-Based (Continued)

31	RI Department of Health	Survery (General Surgery, Neurosurgery, Ophthalmology, Orthopedic Surgery, Otolaryngology, Plastic Surgery, Thoracic Surgery, Urology, Obstetrics and Gynecology)
42	Statewide Health Coordinating Council, State of Michigan	Medicine, Dentistry

Demand/Productivity-Based

Ref. No.	Authors	Health Profession
14	Michigan Commission on Future of Higher Education	Medicine, Dentistry
16	East Central Michigan HSA	Primary Care, Dentistry, Allied Health
23	NY State Education Department	Primary Care, Medical, Surgical and Direct Specialties
24	North Central GA HSA	Primary Care (General/ Family Practice, Pediatrics, Internal Medicine, Ob/Gyn)
27	Office of Health and Medical Affairs, State of Michigan	Medicine
41	State of Kansas SHCC and Department of Health and Environment	Primary, Secondary and Tertiary Medical Specialties
35	Rosenbaum	Dentistry
38	State Council of Higher Education for Virginia	Dentistry
39	State Council of Higher Education for Virginia	Primary Care Medicine
40	State Council of Higher Education for Virginia	Pharmacy
52	Utah HSA	Primary Care Medicine
54	Wisconsin Department of Health and Social Services	Medicine
55	Wisconsin Department of Health and Social Services	Medicine

Professional Judgement-Based

Ref. No.	Authors	Health Profession
12	Chilton, et al. (New Mexico)	Primary Care
25	North Central Georgia HSA (Vol. III)	Primary Care Medicine
43	Tokuhata et al. (Pennsylvania)	All Health Manpower

HMO-Based

Ref. No.	Authors	Health Profession
27	Office of Health and Medical Affairs, State of Michigan	Medicine
42	Statewide Health Coordinating Council, State of Michigan	Medicine, Dentistry

Table 3-2 Range of Selected Requirements Ratios by Profession and Methodology - National Studies

Health Profession	Medical Need		Demand/Productivity		Professional Judgement		HMO	
	Profs./ 100,000 Pop.	Pop./ Health Prof.	Profs./ 100,000 Pop.	Pop./ Health Prof.	Profs./ 100,000 Pop.	Pop./ Health Prof.	Profs./ 100,000 Pop.	Pop./ Health Prof.
MEDICINE								
All Physicians	184.3	540	224.0-244.3	410-450				
Allergy and Immunology	0.8	121,780			2.0-4.0	11,270-25,000		
Anesthesiology	8.9	11,270			2.6-19.3	5,180-38,910		30,560-90,000
Cardiology	3.1	32,210			4.0	25,000		
Child Psychiatry	3.6	27,740						
Colon and Rectal Surgery					0.1-0.2	621,120-666,670		
Dermatology	2.8	35,920			2.5	40,000	3.2	31,250-100,000
Emergency Medicine	5.4	18,490						
Endocrinology	0.8	121,780						
Gastroenterology	2.6	38,410			2.0	50,000		
General/Family Medicine	20.6-35.9	2,780-4,860			50.0	2,000		
Hematology/Oncology	3.6	27,740						
Infectious Disease	0.9	110,960						
Internal Medicine	28.1-96.0	1,040-3,550			9.6-20.0	5,000-10,460		2,300-8,400
Neonatology	0.5	192,040	0.4	226,610				
Nephrology	1.1	90,780						
Neurology	3.3-5.4	18,360-29,900	3.4-4.8	20,670-30,410	1.7	60,000		90,000-129,330
Neurosurgery	1.1	94,210	1.0	101,160	0.8-1.0	100,000-121,800		54,840-145,000
Nuclear Medicine	1.7	58,060						
Ob/Gyn	9.6	10,400	6.2	16,030	5.8-9.1	11,000-17,120		9,000-14,500
Ophthalmology	4.6-11.3	8,860-21,520	1.6-3.5	28,640-61,900	3.3-5.0	20,000-30,030		33,330-47,550
Orthopedic Surgery	6.0	16,530	5.8	17,370	3.5-4.0	25,000-28,410		22,050-35,000
Otolaryngology	3.2	31,210	1.7	60,380	2.0-4.0	25,000-50,000		38,860-50,000
Pathology	5.4	18,490			4.1-5.0	20,000-24,390		47,550-145,000
Pediatric Allergy	0.4	277,400						
Pediatric Cardiology	0.5	217,090						
Pediatric Endocrinology	0.3	312,070						
Pediatric Hematology/ Oncology	0.7	151,310						
Pediatric Nephrology	0.1	713,310						

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Table 3-2 Ranges of Selected Requirements Ratios by Profession and Methodology - National Studies (Continued)

Health Profession	Medical Need		Demand/Productivity		Professional Judgement		HMO	
	Profs./ 100,000 Pop.	Pop./ Health Prof.	Profs./ 100,000 Pop.	Pop./ Health Prof.	Profs./ 100,000 Pop.	Pop./ Health Prof.	Profs./ 100,000 Pop.	Pop./ Health Prof.
Podiatric Surgery	0.3-0.6	154,250-328,690			0.2	596,350-650,680		
Podiatrics	11.4-37.0	2,700-8,790			10.0	10,000		4,530-10,360
Phys. Medicine and Rehabilitation	1.3	78,020						
Plastic Surgery	1.1	92,470	1.7	59,050	0.5-2.0	50,000-184,160		
Preventive Medicine	2.9	34,200						
Primary Care	63.1-133.0	750-1,590	40.0	2,500				
Psychiatry	15.4	6,490	5.0	20,000	10.0	10,000		48,500-145,000
Pulmonary Medicine	1.4	69,350			1.0-2.1	45,000-100,000		
Radiology					6.7-11.6	8,640-15,000		25,000-48,330
Radiology (Diagnostic)	7.7	13,000						
Radiology (Therapeutic)	1.0	97,910	0.6-0.9	108,500-170,760				
Rheumatology	0.7	146,860						
Surgery (General)	9.4	10,620			7.2-10.0	10,000-13,850		8,060-17,820
Surgical Specialties			31.8	3,150				
Thoracic Surgery	0.8	121,780	2.1	48,010	1.0-1.3	76,920-100,000		
Urology	3.1	32,420	3.0	33,610	1.8-3.3	30,000-54,950		44,590-100,000
DENTISTRY			33.0-66.3	1,510-3,000				
OPTOMETRY	14.8-31.3	3,190-6,770	10.6-11.4	8,740-9,420				
PHARMACY			62.7-136.6	730-1,600				
Pharmacy (Inst.)			5.4-11.7	8,490-18,510				
PODIATRY	5.9	16,900	5.0	20,000				
VETERINARY MEDICINE			20.9	4,790				

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Table 3-3 Ranges of Selected Requirements Ratios by Profession and Methodology - State Studies

Health Profession	Medical Need		Demand/Productivity		Professional Judgement		HMO	
	Profs./ 100,000 Pop.	Pop./ Health Prof.	Profs./ 100,000 Pop.	Pop./ Health Prof.	Profs./ 100,000 Pop.	Pop./ Health Prof.	Profs./ 100,000 Pop.	Pop./ Health Prof.
ALABAMA								
Medicine			85.8	1,170				
Access Phys			47.2	2,120				
Consultant Phys.			30.2	3,310				
Prof. Services Phys.			8.4	11,870				
GEORGIA								
Primary Care Phys.			24.4	4,090				
KANSAS								
Medicine					151.7	660		
Primary Care					73.0	1,370		
Secondary Care					66.0	1,520		
Tertiary Care					12.7	7,870		
MICHIGAN								
Medicine					171.0	585	138.0	725
Primary Care							72.0	1,400
Dentistry							44.2-46.0	2,175-2,264
NEW MEXICO								
Medicine								
Primary Care			76.9	1,300				
Internal Medicine			26.1	3,830				
GP/FP			34.6	2,890				
Pediatrics			16.3	6,140				
NEW YORK								
Medicine (All Phys.)			178.3-218.1	400-560				
Primary Care			80.9-97.4	1,030-1,240				
Surgical			41.0-51.4	1,950-2,440				
Medical			30.2-37.4	2,680-3,310				
Indirect Care			26.2-32.0	3,120-3,820				
PENNSYLVANIA								
Medicine			66.7	1,500				
Dentistry			33.3	3,000				
Pharmacy			33.3	3,000				
Podiatry			2.5	40,000				
Optometry			6.7	15,000				
Dental Hygiene			5.0	20,000				
Physical Therapy			6.7	15,000				

Table 3-3 Range of Selected Requirements Ratios by Profession and Methodology - State Studies (Continued)

State and Health Profession	Medical Need		Demand/Productivity		Professional Judgement		NMO	
	Profs./ 100,000 Pop.	Pop./ Health Prof.	Profs./ 100,000 Pop.	Pop./ Health Prof.	Profs./ 100,000 Pop.	Pop./ Health Prof.	Profs./ 100,000 Pop.	Pop./ Health Prof.
RHODE ISLAND								
All Surgical Specialties	41.3	2,420						
General Surgery	9.9	10,140						
OB/GYN	10.4	9,630						
Ophthalmology	4.9	20,280						
Orthopedic Surgery	6.4	15,620						
Otolaryngology	3.4	29,780						
Plastic Surgery	1.2	86,640						
Thoracic Surgery	0.8	119,130						
Urology	3.3	30,740						
VIRGINIA								
Medicine								
Primary Care	44.1-56.1	1,780-2,270						
Dentistry								
Dentists	37.4-68.6	1,460-2,670						
Dental Hygienists	6.6-11.8	8,490-15,040						
Dental Assistants	59.3-105.3	950-1,690						
Dental Technicians	10.6-13.8	7,260-9,430						
Pharmacy	45.1-45.4	2,200-2,220						
WISCONSIN								
Medicine								
Total Physicians	158.2-173.0	580-630						
Office-Based Specialists	116.1-132.3	760-860						
Hospital-Based Specialists	27.5-28.5	3,510-3,640						
Non-Patient Related	10.7-11.1	8,990-9,310						
Other	2.4-2.5	39,630-41,070						

Table 3-4 Requirements Ratios for Health Professions

Ref. No.	Health Profession	Year	Professionals Per 100,000 Population	Population Per Professional	Methodology	Author
			NATIONAL STUDIES			
	MEDICINE					
45	All Physicians (MDs + DOs)	1990	224.0	450	Demand/Productivity	USDHHS
		2000	244.3	410		
47	All Physicians (MDs + DOs)	1990	184.3	540	Medical Need	USDHHS
28	Allergy	1972	4.0	25,000	Professional Judgement	Paxton
47	Allergy and Immunology	1990	0.8	121,780	Medical Need	USDHHS
51	Allergy and Immunology	1976	2.0	50,000	Professional Judgement	USGAO
9	Anesthesiology	1990	8.9	11,270	Medical Need	Bowman
18	Anesthesiology	1980	19.3	5,180	Professional Judgement	Knowles
22	Anesthesiology	2000[1/]	3.2	31,450	Professional Judgement	Moore
		1990[1/]	3.1	32,050		
		1985[1/]	3.0	33,330		
		1980[1/]	2.8	35,340		
		1975[1/]	2.6	38,910		
28	Anesthesiology	1972	7.1	14,000	Professional Judgement	Paxton
20	Anesthesiology	1972	---	30,560-90,000	HMO	Mason
47	Cardiology	1990	3.1	32,210	Medical Need	USDHHS
28	Cardiology	1972	4.0	25,000	Professional Judgement	Paxton
47	Child Psychiatry	1990	3.6	27,740	Medical Need	USDHHS
22	Colon and Rectal Surgery	2010[1/]	0.2	621,120	Professional Judgement	Moore
		2005[1/]	0.2	625,000		
		2000[1/]	0.2	632,910		
		1995[1/]	0.2	641,030		
		1990[1/]	0.2	645,160		
		1985[1/]	0.2	653,600		
		1980[1/]	0.1	666,670		
		1975[1/]	0.1	666,670		
47	Dermatology	1990	2.8	35,920	Medical Need	USDHHS
19	Dermatology	1976	3.2	31,250	HMO	Krasner
20	Dermatology	1972	---	32,930-100,000	HMO	Mason
28	Dermatology	1972	2.5	40,000	Professional Judgement	Paxton
47	Emergency Medicine	1990	5.4	18,490	Medical Need	USDHHS
47	Endocrinology	1990	0.8	121,780	Medical Need	USDHHS
47	Gastroenterology	1990	2.6	38,410	Medical Need	USDHHS
28	Gastroenterology	1972	2.0	50,000	Professional Judgement	Paxton
47	General/Family Medicine	1990	24.6	4,070	Medical Need	USDHHS
32	General/Family Medicine	1990	20.6-33.6	2,980-4,860	Medical Need	Roddy
		1980	21.5-35.1	2,850-4,650		
		1975	22.0-35.9	2,780-4,540		
28	General/Family Medicine	1972	50.0	2,000	Professional Judgement	Paxton
47	Hematology/Oncology	1990	3.6	27,740	Medical Need	USDHHS
47	Infectious Disease	1990	0.9	110,960	Medical Need	USDHHS
47	Internal Medicine	1990	28.1	3,550	Medical Need	USDHHS

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Table 3-4 Requirements Ratios for Health Professions (Continued)

Ref. No.	Health Profession	Year	Professionals Per 100,000 Population	Population Per Professional	Methodology	Author
22	Internal Medicine	2000[1/]	11.8	8,450	Professional Judgement	Moore
		1995[1/]	11.7	8,530		
		1990[1/]	11.6	8,620		
		1985[1/]	11.2	8,970		
		1980[1/]	10.5	9,510		
		1975[1/]	9.6	10,460		
32	Internal Medicine	1990	34.4-56.0	1,790-2,910	Medical Need	Roddy
		1980	32.2-52.4	1,910-3,110		
		1975	28.9-47.0	2,130-3,470		
20	Internal Medicine	1972	---	2,300-8,440	HMO	Mason
28	Internal Medicine	1972	20.0	5,000	Professional Judgement	Paxton
36	Internal Medicine	1972	96.0	1,040	Medical Need	Schonfeld
1	Neonatology	1980	0.4	226,610	Demand/Productivity	American Academy of Pediatrics
47	Neonatology	1990	0.5	192,040	Medical Need	USDHHS
47	Nephrology	1990	1.1	90,780	Medical Need	USDHHS
9	Neurology	1990	3.3	29,900	Medical Need	Bowman
15	Neurology	1990	3.4-4.8	20,670-30,410	Demand/Productivity	Dyken
36	Neurology	1985	5.0-5.4	18,360-19,890	Medical Need	Yahr
20	Neurology	1972	---	90,000-129,330	HMO	Mason
28	Neurology	1972	1.7	60,000	Professional Judgement	Paxton
47	Neurosurgery	1990	1.1	94,210	Medical Need	USDHHS
53	Neurosurgery	1990	1.0	101,160	Demand/Productivity	Williams
22	Neurosurgery	2010[1/]	0.9	113,640	Professional Judgement	Moore
		2005[1/]	0.9	114,680		
		2000[1/]	0.9	115,880		
		1995[1/]	0.9	117,100		
		1990[1/]	0.8	118,200		
		1985[1/]	0.8	119,330		
		1980[-/]	0.8	120,630		
		1975[1/]	0.8	121,800		
20	Neurosurgery	1972	---	54,840-145,000	HMO	Mason
28	Neurosurgery	1972	1.0	100,000	Professional Judgement	Paxton
9	Nuclear Medicine	1990	1.7	58,060	Medical Need	Bowman
47	Obstetrics-Gynecology	1990	9.6	10,400	Medical Need	USDHHS
53	Obstetrics-Gynecology	1990	6.2	16,030	Demand/Productivity	Williams
22	Obstetrics-Gynecology	2010[1/]	6.2	16,130	Professional Judgement	Moore
		2005[1/]	6.1	16,310		
		2000[1/]	6.1	16,470		
		1995[1/]	6.0	16,640		
		1990[1/]	6.0	16,780		
		1985[1/]	5.9	16,950		
		1980[1/]	5.8	17,120		
		1975[1/]	5.8	17,300		

Table 3-4 Requirements Ratios for Health Professions (Continued)

Ref. No.	Health Profession	Year	Professionals Per 100,000 Population	Population Per Professional	Methodology	Author
20	Obstetrics-Gynecology	1972	---	9,000-14,500	HMO	Mason
28	Obstetrics-Gynecology	1972	9.1	11,000	Professional Judgement	Paxton
47	Ophthalmology	1990	4.6	21,520	Medical Need	USDHHS
53	Ophthalmology	1990	1.6	61,900	Demand/Productivity	Williams
44	Ophthalmology	1990	2.8-3.5	28,640-35,660	Demand/Productivity	Trobe
22	Ophthalmology	2010[1/]	3.5	28,250	Professional Judgement	Moore
		2005[1/]	3.5	28,570		
		2000[1/]	3.5	28,820		
		1995[1/]	3.4	29,160		
		1990[1/]	3.4	29,410		
		1985[1/]	3.4	29,670		
		1980[1/]	3.3	30,030		
		1975[1/]	3.3	30,300		
30	Ophthalmology	1977	7.5-11.3	8,860-13,300	Medical Need	Reinecke
20	Ophthalmology	1972	---	33,330-47,550	HMO	Mason
28	Ophthalmology	1972	5.0	20,000	Professional Judgement	Paxton
47	Orthopedic Surgery	1990	6.0	16,530	Medical Need	USDHHS
22	Orthopedic Surgery	2010[1/]	3.8	26,460	Professional Judgement	Moore
		2005[1/]	3.7	26,740		
		2000[1/]	3.7	27,030		
		1995[1/]	3.7	27,250		
		1990[1/]	3.6	27,550		
		1985[1/]	3.6	27,780		
		1980[1/]	3.6	28,090		
		1975[1/]	3.5	28,410		
53	Orthopedic Surgery	1990	5.8	17,370	Demand/Productivity	Williams
20	Orthopedic Surgery	1972	---	22,050-35,000	HMO	Mason
28	Orthopedic Surgery	1972	4.0	25,000	Professional Judgement	Paxton
47	Otolaryngology	1990	3.2	31,210	Medical Need	USDHHS
53	Otolaryngology	1990	1.7	60,380	Demand/Productivity	Williams
22	Otolaryngology	2010[1/]	2.1	46,730	Professional Judgement	Moore
		2005[1/]	2.1	47,170		
		2000[1/]	2.1	47,620		
		1995[1/]	2.1	47,620		
		1990[1/]	2.1	48,540		
		1985[1/]	2.0	49,020		
		1980[1/]	2.0	49,510		
		1975[1/]	2.0	50,000		
20	Otolaryngology	1972	---	38,860-50,000	HMO	Mason
28	Otolaryngology	1972	4.0	25,000	Professional Judgement	Paxton
47	Pathology	1990	5.4	18,490	Medical Need	USDHHS
22	Pathology	2000	4.8[1/]	20,920	Professional Judgement	Moore
		1995	5.0[1/]	19,920		
		1990	5.0[1/]	20,120		
		1985	4.8[1/]	20,920		
		1980	4.5[1/]	22,170		
		1975	4.1[1/]	24,390		

Table 3-4 Requirements Ratios for Health Professions (Continued)

Ref. No.	Health Profession	Year	Professionals Per 100,000 Population	Population Per Professional	Methodology	Author
20	Pathology	1972	---	47,550-145,000	HMO	Mason
28	Pathology	1972	5.0	20,000	Professional Judgement	Paxton
47	Pediatric Allergy	1990	0.4	277,400	Medical Need	USDHHS
47	Pediatric Cardiology	1990	0.5	217,090	Medical Need	USDHHS
47	Pediatric Endocrinology	1990	0.3	312,070	Medical Need	USDHHS
47	Pediatric Hematology/Oncology	1990	0.7	151,310	Medical Need	USDHHS
47	Pediatric Nephrology	1990	0.1	713,310	Medical Need	USDHHS
26	Pediatric Surgery	1980	0.2	596,350-650,680	Professional Judgement	O'Neill
29	Pediatric Surgery	1985	0.3-0.6	154,250-328,690	Medical Need	Ravitch
47	Pediatrics	1990	12.1	8,250	Medical Need	USDHHS
32	Pediatrics	1990	11.7-19.1	5,240-8,550	Medical Need	Roddy
		1980	11.4-18.6	5,390-8,790		
		1975	12.2-19.9	5,010-8,180		
20	Pediatrics	1972	---	4,550-10,360	HMO	Mason
28	Pediatrics	1972	10.0	10,000	Professional Judgement	Paxton
36	Pediatrics	1972	37.0	2,700	Medical Need	Schoenfeld
47	Physical Medicine and Rehabilitation	1990	1.3	78,020	Medical Need	USDHHS
47	Plastic Surgery	1990	1.1	92,470	Medical Need	USDHHS
53	Plastic Surgery	1990	1.7	59,050	Demand/Productivity	Williams
22	Plastic Surgery	2010[1/]	0.6[1/]	171,820	Professional Judgement	Moore
		2005[1/]	0.6[1/]	173,310		
		2000[1/]	0.6[1/]	175,130		
		1995[1/]	0.6[1/]	176,990		
		1990[1/]	0.6[1/]	178,890		
		1985[1/]	0.6[1/]	180,510		
		1980[1/]	0.5[1/]	182,480		
		1975[1/]	0.5[1/]	184,160		
28	Plastic Surgery	1972	2.0	50,000	Professional Judgement	Paxton
47	Preventive Medicine	1990	2.9	34,200	Medical Need	USDHHS
32	Primary Care	1990	66.7-108.6	920-1,500	Medical Need	Roddy
		1980	65.1-106.1	940-1,540		
		1975	63.1-102.8	970-1,590		
49	Primary Care	1980	40.0	2,500	Demand/Productivity	USDHEW
36	Primary Care	1972	133.0	750	Medical Need	Schoenfeld
47	Psychiatry	1990	15.4	6,490	Medical Need	USDHHS
49	Psychiatry	1980	5.0	20,000	Demand/Productivity	USDHEW
20	Psychiatry	1972	---	48,500-145,000	HMO	Mason
28	Psychiatry	1972	10.0	10,000	Professional Judgement	Paxton
47	Pulmonary Medicine	1990	1.4	69,350	Medical Need	USDHHS
6	Pulmonary Medicine	1990	1.6-1.9	51,000-61,000	Professional Judgement	American Thoracic Society
		1980	2.1	45,000		
28	Pulmonary Medicine	1972	1.0	100,000	Professional Judgement	Paxton

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Table 3-4 Requirements Ratios for Health Professions (Continued)

Ref. No.	Health Profession	Year	Professionals Per 100,000 Population	Population Per Professional	Methodology	Author
18	Radiology	1975	9.3-11.6	8,640-10,800	Professional Judgement	Knowles
20	Radiology	1972	---	25,000-48,330	HMO	Mason
28	Radiology	1972	6.7	15,000	Professional Judgement	Paxton
47	Radiology (Diagnostic)	1990	7.7	13,000	Medical Need	Bowman
47	Radiology (Therapeutic)	1990	1.0	97,910	Medical Need	Bowman
2	Radiology (Therapeutic)	1990	0.9	107,610	Demand/Productivity	American College of Radiology
		1989	0.9	108,600		
		1988	0.9	108,600		
		1987	0.9	109,550		
		1986	0.9	110,590		
		1985	0.9	110,580		
		1984	0.9	111,750		
		1983	0.9	111,790		
		1982	0.9	112,950		
		1981	0.9	114,050		
3	Radiology (Therapeutic)	2000	0.6-0.7	139,130-159,310	Demand/Productivity	American College of Radiology
		1990	0.6-0.7	137,170-158,410		
		1980	0.6-0.7	147,690-166,110		
		1973	0.6	170,760		
47	Rheumatology	1990	0.7	146,860	Medical Need	USDHHS
47	Surgery (General)	1990	9.4	10,620	Medical Need	USDHHS
22	Surgery (General)	2010[1/]	7.7	12.920	Professional Judgement	Moore
		2005[1/]	7.7	13,040		
		2000[1/]	7.6	13,180		
		1995[1/]	7.5	13,320		
		1990[1/]	7.4	13,440		
		1985[1/]	7.4	13,570		
		1980[1/]	7.3	13,720		
		1975[1/]	7.2	13,850		
20	Surgery (General)	1972	---	8,060-17,820	HMO	Mason
28	Surgery (General)	1972	10.0	10,000	Professional Judgement	Paxton
53	Surgical Specialties	1990	31.8	3,150	Demand/Productivity	Williams
47	Thoracic Surgery	1990	0.8	121,780	Medical Need	USDHHS
53	Thoracic Surgery	1990	2.1	48,010	Demand/Productivity	Williams
22	Thoracic Surgery	2010[1/]	1.3	76,920	Professional Judgement	Moore
		2005[1/]	1.3	78,130		
		2000[1/]	1.3	78,740		
		1995[1/]	1.3	79,370		
		1990[1/]	1.2	80,000		
		1985[1/]	1.2	81,300		
		1980[1/]	1.2	81,970		
		1975[1/]	1.2	82,650		

Table 3-4 Requirements Ratios for Health Professions (Continued)

Ref. No.	Health Profession	Year	Professionals Per 100,000 Population	Population Per Professional	Methodology	Author
28	Thoracic Surgery	1972	1.0	100,000	Professional Judgement	Paxton
47	Urology	1990	3.1	32,420	Medical Need	USDHHS
53	Urology	1990	3.0	33,610	Demand/Productivity	Williams
22	Urology	2010[1/]	2.0	51,020	Professional Judgement	Moore
		2005[1/]	1.9	51,550		
		2000[1/]	1.9	52,080		
		1995[1/]	1.9	52,630		
		1990[1/]	1.9	53,190		
		1985[1/]	1.9	53,760		
		1980[1/]	1.8	54,350		
		1975[1/]	1.8	54,950		
20	Urology	1972	---	44,590-100,000	HMO	Mason
28	Urology	1972	3.3	30,000	Professional Judgement	Paxton
	DENTISTRY					
45	Dentistry	2000	62.8	1,590	Demand/Productivity	USDHHS
		1990	61.8	1,620		
49	Dentistry (Shortage Area Criteria)	1980	33.0	3,000	Demand/Productivity	USDHEW
13	Dentistry	1980	53.6-66.3	1,510-1,870	Demand/Productivity	Cole
	OPTOMETRY					
45	Optometry	2000	11.4	8,740	Demand/Productivity	USDHHS
		1990	10.6	9,420		
4	Optometry	1990	14.8-31.3	3,190-6,770	Medical Need	American Optometric Assoc.
	PHARMACY					
45	Pharmacy	2000	64.9	1,540	Demand/Productivity	USDHHS
		1990	64.1	1,560		
34	Pharmacy	1985	136.6	730	Demand/Productivity	Rodowskas
		1980	105.3	950		
		1975	79.9	1,250		
		1970	62.7	1,600		
33	Pharmacy (Institutional)	1985	5.4-11.7	8,490-18,510	Demand/Productivity	Rodowskas
	PODIATRY					
49	Podiatry (Shortage Area Criteria)	1980	5.0	20,000	Demand/Productivity	USDHHS
5	Podiatry	1976	5.9	16,900	Medical Need	American Podiatry Assoc.

Table 3-4 Requirements Ratios for Health Professions (Continued)

Ref. No.	Health Profession	Year	Professionals Per 100,000 Population	Population Per Professional	Methodology	Author
	VETERINARY MEDICINE					
45	Veterinary Medicine	2000	20.9	4,790	Demand/Productivity	USDHHS

1/ Midpoint of the range of years for which estimate was calculated

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Table 3-4 Requirements Ratios for Health Professions (Continued)

Ref. No.	State and Health Profession	Year	Professionals Per 100,000 Population	Population Per Professional	Methodology	Author
			STATE STUDIES			
	ALABAMA					
10	Medicine (All Physicians)	1975	85.8	1,170	Demand/Productivity	Bridgers
	Access Physicians		47.2	2,120		
	Consultant Physicians		30.2	3,310		
	Prof. Services Physicians		8.4	11,870		
	GEORGIA					
24	Medicine (All Physicians)					
	Primary Care Phys. (HSA)	2000	24.4	4,090	Demand/Productivity	North Central GA HSA
	KANSAS					
41	Medicine (All Physicians)	1982	151.7	660	Professional Judgement	Kansas SHCC
	Primary Care		73.0	1,370		
	Secondary Care		66.0	1,520		
	Tertiary Care		12.7	7,870		
	MICHIGAN					
14	Medicine (All Physicians)	1982	171.0	585	Professional Judgement	CFHE
27	Medicine	1990	138.0[2/]	725	HMO (Adjusted)	OMHA
	Primary Care		72.0	1,400		
14	Dentistry	1990	46.0	2,175	HMO (Adjusted)	CFHE
42	Dentistry	1983	44.2[2/]	2,264	HMO (Adjusted)	SHCC
	NEW MEXICO					
	Medicine (All Physicians)					
12	Primary Care	1990	76.9	1,300	Demand/Productivity	Chilton
	Internal Medicine		26.1	3,830		
	General/Family Practice		34.6	2,890		
	Pediatrics		16.3	6,140		
	NEW YORK					
23	Medicine (All Physicians)	1980	178.3	560	Demand/Productivity	University of the State of New York
	Primary Care		80.9	1,240		
	Surgical		41.0	2,440		
	Medical		30.2	3,310		
	Indirect Care		26.2	3,820		

2/ Full Time Equivalent

Table 3-4 Requirements Ratios for Health Professions (Continued)

Ref. No.	State and Health Profession	Year	Professionals Per 100,000 Population	Population Per Professional	Methodology	Author
	NEW YORK (Continued)					
	Medicine (All Physicians)	1990	193.8	520		
	Primary Care		86.9	1,150		
	Surgical		45.6	2,190		
	Medical		32.8	3,050		
	Indirect Care		28.6	3,500		
23	Medicine (All Physicians)	2000	218.1	460		
	Primary Care		97.4	1,030		
	Surgical		51.4	1,950		
	Medical		37.4	2,680		
	Indirect Care		32.0	3,120		
	PENNSYLVANIA					
43	Medicine	1975	66.7	1,500	Demand/Productivity	Tokuhata
	Dentistry		33.3	3,000		
	Pharmacy		33.3	3,000		
	Podiatry		2.5	40,000		
	Optometry		6.7	15,000		
	Dental Hygiene		5.0	20,000		
	Physical Therapy		6.7	15,000		
	RHODE ISLAND					
31	All Surgical Specialties	1982	41.3	2,420	Medical Need	Rhode Island Department of Health
	General Surgery		9.9	10,140		
	OB/GYN		10.4	9,630		
	Ophthalmology		4.9	20,280		
	Orthopedic Surgery		6.4	15,620		
	Otolaryngology		3.4	29,780		
	Plastic Surgery		1.2	86,640		
	Thoracic Surgery		0.8	119,130		
	Urology		3.3	30,740		
	VIRGINIA					
39	Medicine					
	Primary Care	1980	44.1-55.2	1,810-2,270	Demand/Productivity	State Council of Higher Education for Virginia
		1985	44.3-55.5	1,800-2,260		
		1990	44.6-55.9	1,790-2,240		
		1995	44.9-56.1	1,780-2,230		

Table 3-4 Requirements Ratios for Health Professions (Continued)

Ref. No.	State and Health Profession	Year	Professionals Per 100,000 Population	Population Per Professional	Methodology	Author
38	Dentistry					
	Dentists	1980	39.8-53.1	1,880-2,510	Demand/Productivity	State Council for Higher Education for Virginia
		1990	37.4-68.6	1,460-2,670		
	Dental Hygienists	1980	6.6-6.9	14,440-15,040		
		1990	8.6-11.8	8,490-11,640		
	Dental Assistants	1980	59.3-62.0	1,610-1,690		
		1990	76.6-105.3	950-1,310		
	Dental Technicians	1980	10.6	9,420		
		1990	13.8	7,260		
40	Pharmacy	1980	45.1	2,220	Demand/Productivity	State Council for Higher Education for Virginia
		1990	45.4	2,200		
	WISCONSIN					
55	Medicine					
	Total Physicians	1990	158.2-169.1	590-630	Demand/Productivity	Wisconsin Dept. of Health and Special Services
	Office Based Specialties		116.1-126.9	790-860		
	Hospital-Based Specialties		28.5	3,510		
	Non-Patient Related		11.1	8,990		
	Other		2.5	39,630		
	Total Physicians	2000	161.6-173.0	580-620		
	Office-Based Specialties		121.0-132.3	760-830		
	Hospital-Based Specialties		27.5	3,640		
	Non-Patient Related		10.7	9,310		
	Other		2.4	41,070		

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CHAPTER 4

ABSTRACTS OF SELECTED HEALTH MANPOWER REQUIREMENTS STUDIES

Introduction

The following abstracts, presented in alphabetical order according to author, summarize the health manpower requirements studies selected for inclusion in this report. They support the health manpower requirements ratios discussed in the previous chapter. The abstracts are written in a format enabling the reader to follow the justification of their inclusion in this report. A brief summary of the methodology is included along with the date of the study and underlying factors and assumptions. Careful analysis of these factors and assumptions by the reader is imperative. These factors not only explain the variation in the ratios previously presented but also outline information that may or may not justify the derived ratios the report develops.

Format of the Selected Abstracts

Reference Number. A number has been placed in the upper left-hand corner of each individual abstract for reference purposes. These reference numbers are used in the ratio tables presented in Chapter Three and cited throughout this report.

Bibliographic Information. The title, author, and other bibliographic information such as journal name, volume number, etc., along with the sponsor of the study, if identified, are presented for each study for reference purposes.

Professions Covered. A list of the health professions and sub-specialties for which the health manpower requirements estimates are developed is presented for each study.

Abstract. Each abstract reports the following relevant information for each study: (1) the purpose of the study; (2) a brief summary of the methodology used; See Table 3-1 for a summary of studies by methodology cluster); (3) the time period of the study, if available; (4) a brief discussion of presented unique assumptions and limitations of the study if available; and (5) the health manpower requirement estimates presented (found either in the context of the abstract or an appended table).

Underlying Factors/Assumptions. A list of the categorized underlying factors and/or assumptions either explicitly or implicitly considered in the development and application of the methodology is presented for each study according to their description in Chapter Two of this report.

Reference No. 1	Estimates of Need and Recommendations for Personnel in Neonatal Pediatrics

Author(s): American Academy of Pediatrics, Committee on Fetus and Newborn and Committee of the Section on Perinatal Pediatrics

Publication Information: Pediatrics, Vol. 65, No. 4 (April 1980), pp. 850-853

Sponsor: American Academy of Pediatrics

Professions Covered: Neonatology

Abstract:

This study detailed the activities of the American Academy of Pediatrics Committee on the Fetus and Newborn and the section on Perinatal Pediatrics relating to their examination of neonatal pediatric practice and manpower needs. Estimates of the number of neonatology subspecialists needed were based on according to the three-level care system. The Committees calculated two estimates for the number of neonatologists required for Level III care. The first estimate that does not address nonpatient care activities was based on the average daily census of patients, derived from estimates of newborns requiring special care (assumptions unclear), with either six or eight patients per neonatologist. The second estimate was based on a 1979 survey identifying 275 Level III units and three neonatologists per unit. This estimate does not consider the opening of new Level II facilities. The average of these two estimates for neonatologists required for Level III care was 625. The committee stated that estimates of need for Level II neonatologists, were more difficult to derive because of the portion of care provided by other health personnel. Several alternatives were presented for estimating Level II neonatologist need by the number of neonatologists and the number of patients per neonatologist. The method used to calculate total neonatologists needed was based on 1/2 Level II patients and 12 patients/neonatologist. Level III needs (625) and Level II needs (380) were summed to calculate a total 1980 need of 1,005 neonatologists. Based on a 1980 projected supply of 860 neonatologists the committee projects a shortage of 275 neonatlogists.

Assumptions/Underlying Factors:

Prevalence/Incidence of Disease Conditions (A)(4)
Case Loads Per Health Professional (I)(3)
Setting of Care (M)(2)
Health Condition (Status) (U)(4)
Type of Care (W)(2/3)

Reference No. 2	Position of the American College of Radiology Regarding the GMENAC Report for Five Hospital-Based Specialties

Author(s): American College of Radiology

Publication Information: October, 1983

Sponsor: American College of Radiology

Professions Covered: Therapeutic Radiology

Abstract:

The purpose of this report was to document the position of the American College of Radiology (ACR) on the Graduate Medical Education National Advisory Committee's (GMENAC's) estimates of the need for and supply of radiologists for 1990. In regard to radiology manpower requirements for 1990, ACR took no official position on GMENAC's 1990 diagnostic radiology manpower requirements on the basis that it is uncertain as to how the impact of the major changes in the field of diagnostic radiology will affect manpower requirements in this field. However, in the field of therapeutic radiology, the ACR projects a manpower requirement of 2,320 for 1990 which is 206 fewer than GMENAC's estimates. These estimates are based on the assumption that therapeutic radiology manpower requirements are highly correlated to the incidence of cancer. The ACR derived therapeutic radiology for each year of the period 1981-1990 based on the number of cancer patients per 1,000 population for these years (PCS data). It was assumed that one theurapeutic radiologist (expressed in full-time equivalent (FTE) could provide care for 200 patients per year and that patient care provided by radiology faculty members contributed 0.5 FTE and radiology residents, 0.35 FTE. The total number of radiology patients per year was calculated by multiplying the U.S. population for that year by the number of patients per 1,000 population, 80% of that being radiology patient care provided in community hospitals and 20% in teaching centers. The supply of radiology residents was multiplied by 0.35 FTE to calculate the number of FTE-resident patient care contribution. The total number of radiology faculty members needed to provide patient care was calculated by dividing the number of teaching center patients per year by 220 FTE, subtracting the number of FTE residents, and then dividing by 0.5 FTE. The number of community therapeutic radiologist required per year was calculated by dividing the number of community hospital patients per year by 200 FTE. Community hospital and teaching center therapeutic radiologists were added to estimate the total number of required per year (see following table). This report also described the ACR estimates for radiology manpower supply for 1990 which also differ from GMENAC estimates.

Assumptions:

Prevalence/Incidence of Disease Conditions (A)(2)
Consideration of Selected Disease Conditions (B)(3)
Case Loads Per Health Professional (I)(3)
Setting of Care (M)(1/3)

Table 1. ACR Estimates of Requirements for Therapeutic Radiologists 1981-1980 (Supply and Shortfall Figures for Board Certified Only)

Year	U.S. pop x 10^8	Pt/1000[1]	Intensity Ratio[2]	TR Reqd.	Table 1 Supply	Shortfall[3]	Shortfall[4]
1981	2.34	1.76	1.00	2017	1824	193	193
1982	2.37	1.77	1.02	2057	1853	204	204
1983	2.40	1.78	1.04	2098	1899	199	179
1984	2.42	1.79	1.05	2118	1930	188	148
1985	2.44	1.80	1.07	2158	1958	200	140
1986	2.46	1.81	1.08	2178	1993	185	105
1987	2.48	1.82	1.10	2219	2045	174	74
1988	2.51	1.83	1.12	2259	2094	165	45
1989	2.53	1.84	1.13	2279	2140	130	-
1990	2.55	1.85	1.15	2320	2183	137	(23)

[1]PCS data (current, with increases based upon both population aging and cancer increase in incidence)

[2]Based upon U.S. Population x pt/1000 (1982-1990)/Population x pt/1000 (1981)

[3]Shortfall using existing certification rate

[4]Shortfall if certification rate 100% of current (110) number of residents/yr

Reference No. 3	Manpower III: A Report of the ACR Committee on Manpower

Author(s): American College of Radiology

Publication Information: January 1982

Sponsor: American College of Radiology

Professions Covered: Radiology

Abstract:

Manpower III focused on the 1980 and 1981 studies by the American College of Radiology (ACR) and incorporated information from other contemporary radiology manpower studies. Conclusions made in the 1977 ACR Manpower II report were updated. The 1980-A study consisted of questionnaires mailed to 2,952 U.S. radiologists certified by the American Board of Radiology in the years 1976-1979 and resulted in a 59% response rate. The 1980-B study consisted of "needs of practices" questionnaires mailed to 974 radiologists, who represented a random sample of 15% of ACR members certified before 1972, that resulted in a "useable" 39% response rate. The Patterns of Case Study (assumed to be 1980-A study), there was an estimated a supply of 7000 part-time radiologic physician personnel who were providing a certain amount of radiation therapy. A committee member estimated their contribution to be equivalent to 200 full-time equivalent (FTE) radiation therapists. Table I below presents estimates for the required number of radiation therapists for clinical care based on the inidence of cancer and the following two assumptions: 1) that the number of part-time therapists (PTT) remains at the 1973 level; and 2) that the number of PTT therapists would decrease to zero by 1983. Also, heads of practices were asked to project their radiology manpower needs through 1990. Estimates were provided by 275 practices. An average of 2.3 radiologists per practice was the estimated need. Table II below presents the predicted needs for 1990 in percents. The ACR stated that, "while these figures do not provide a reliable basis for projecting actual numbers, they may be of interest in estimating the types of radiologists needed."

Assumptions:

Prevalence of Disease Condition (A)(4)
Consideration of Unrelated Conditions (B)(3)
Case Loads Per Health Professional (I)(H)

TABLE 1

Estimated Number of Therapists Required in the United States with Projections for Population Growth and Change in Cancer Incidence Rates

Year	Population in Thousands	Cancer Incidence/ Thousand/ Year	No. of Therapists Required (PTT Remain at 1973 Level)	No. of Therapists Required (PTT Decreased to Zero by 1983)
1973	208,689	2.98	1,241	1,241
1980	222,470	3.04	1,371	1,542
1990	244,977	3.11	1,576	1,820
2000	262,764	3.07	1,682	1,926

TABLE 2

Radiologists by Type
Predicted Needs for 1990 (In Percent)

Gen. Diag. Rad.	Ped. Rad.	Neuro. Rad.	Cardiac Rad.	Vasc. Rad.	Other Diag. Rad.	Therap. Rad.	Nucl. Rad.	Ultra-sound	Other
65.5	2.7	3.5	.80	2.4	4.3	11.0	5.2	2.7	1.7

Reference No. 4	Report of the AOA Task Force on Optometric Manpower

Author(s): American Optometric Association Task Force on Optometric Manpower

Publication Information: March 1982

Sponsor: American Optometric Association

Professions Covered: Optometry, Opticians, Ophthalmology

Abstract:

In 1978 the AOA was directed by Congress to conduct a study to determine optometric manpower needs based on incidence, prevalence and remediation of conditions of the vision system, and the possible impact of a national program of health care. In an attempt to project requirements, a survey of a group of optometrists was conducted to obtain practice data concerning patient populations with specified conditions, the time involved in treatment and diagnosis, and frequency of follow-up treatments and examinations. This report presented the task force's findings for this study.

The survey was designed by the task force and mailed to 286 optometrists practicing a relatively broad scope of primary care. Valid responses were received from 137 (48%). The model projected "need for care" in 1990 by using four data sets: expected prevalence of conditions or problems; distribution of probable treatment modes for each condition; average time necessary to deliver services for each treatment mode; and estimated need for diagnostic services by the population in 1990. The overall projection of needs in 1990 was 76,334 if optometrists were to provide all primary vision care needs. Adjustments were made to project a realistic estimate of manpower needs in 1990. These adjustments included: (1) demand would be half the estimate need for diagnostic care; (2) opthalmologists and other practioners would provide 35% of primary care; and (3) an additional 5% increase in O.D.s was required for education, research, and administration. This resulted in an adjusted estimate of 35,998 optometrists in 1990, or 14.8/100,000 population.

Assumptions/Underlying Factors:

Prevalence of Disease Conditions (A)(2)
Utilization Rates (G)(2)
Time Required to Produce Services or Visits (H)(2)
Type of Care (W)(2)

Reference No. 5	An Assessment of Foot Health Problems and Related Health Manpower Utilization and Requirements

Author(s): American Podiatry Association

Publication Information: American Podiatry Association; August 10, 1976

Sponsor: American Podiatry Association

Professions Covered: Foot Care Practitioners (FTE-Podiatry, Orthopedic Surgeons, General Medicine)

Abstract:

In 1976, the American Podiatry Association conducted a study to assess foot health problems in the U.S. and the associated need, utilization, costs, and manpower factors. In order to assess the number of full-time equivalent (FTE) foot care practitioners required in 1976, the Association determined the number of visits per year for soft tissue complaints and static foot deformities. It should be noted that for supply estimates it was assumed that orthopedic surgeons devote approximately 20% of their practice to foot health problems and general practitioners, 3%. Thus podiatrists, orthopedic surgeons, and general practitioners contribute to the FTE foot care practitioner category. The number of annual visits needed was based on the incidence and prevalence of conditions needing care (NCHS data), expert panel consensus on the "percentage of persons likely to require professional attention during the next 12 months", and the average number of visits required per person who has a given foot health problem. An annual productivity of 4,000 conditions per foot care practitioner was assumed for the Northeast, North Central, and West regions of the U.S., while an annual productivity of 5,000 was assumed for the south where the density of foot care practitioners was low. In order to treat soft tissue complaints and static deformities, a total of 12,865 foot care practitioners would be required for 1976. Regional requirements were as follows: Northeast-3,176; North Central-3,350; South-4,240; and, West-2,100. It is further stated that these estimates only apply to foot disorders for which prevalence data wereavailable. If the approximately 20 million visits which involve other foot disorders were added, the estimated requirements would be even greater.

Assumptions/Underlying Factors:

Prevalence/Incidence of Disease Conditions (A)(2)
Consideration of Selected Disease Conditions (B)(3)
Utilization Rates (G)(1/3)
Case Loads Per Health Professional (I)(2/3)
Role Definition of Health Professionals (N)(3)
Geographic Location (X)(3)
Physician Density (4)(1)

Reference No. 6	**Pulmonary Manpower Report--Report and Recommendations of the Ad Hoc Committee on Pulmonary Manpower, American Thoracic Society, Final Report, October 1982**

Author(s): American Thoracic Society, Ad Hoc Committee on Pulmonary Manpower

Publication Information: American Review of Respiratory Disease, Vol. 127, No. 5 (May 1983), pp. 665-670

Sponsor: American Thoracic Society

Professions Covered: Pulmonology

Abstract:

In 1981 the American Thoracic Society Ad Hoc Committee on Pulmonary Manpower was assigned four tasks: (1) to evaluate the GMENAC report concerning pulmonary manpower; (2) to evaluate the current need and project the need over the next 10 years for adult pulmonary disease academians; (3) to develop a position regarding evaluation of pulmonary training programs; and (4) to address geographic maldistribution of pulmonary manpower to identify underserved areas and suggest possible solutions. The Committee developed an alternative method of estimating pulmonary manpower needs under the assumption that a pulmonary physician primarily practices at a hospital rather than a separate ambulatory care facility. Therefore, the Committee assumed that there was a minimal hospital size that justified the full services of a pulmonologist which was determined to be a hospital with an average daily census of 150 occupied beds. Larger hospitals would require additional pulmonologists for every additional increment of 150 occupied beds. On this basis, the 1980 estimate for the number of pulmonologists needed was 4,848 or 1/145,000 persons. No references to data sources were given. The Committee also stated that the ideal number of chest physicians required in 1990 should be between 4,000 and 9,800 (1/61,000 or 1/51,000) but the methodology, data sources, and assumptions used to determine this estimation were unclear.

Assumptions/Underlying Factors:

Minimal Hospital Size Standard (3)

Reference No. 7	**Third Report of the ASCP/CAP/APC Joint Task Force on Pathology Manpower**

Author(s): Anderson, Robert E., M.D.; Benson, Ellis S., M.D.; Reals, William J., M.D.; Steinbridge, Vernie A., M.D.; Cowan, William B., M.D., M.C., Col.; Hanson, Stephen M., M.D.; Bostick, Warren L., M.D.; Carter, Jan A.; Williams, Marjorie, M.D.; Bergnes, Manuel A., M.D.; Battaile, William G., M.D.; Bywaters, David ; Conn, Rex B., Jr., M.D.; and Bridgens, James G., M.D.

Publication Information: American Journal of Clinical Pathology, Vol. 77, No. 5 (May 1982)

Sponsors: Joint Committee of: American Society of Clinical Pathologist (ASCP); College of American Pathologist (CAP); Association of Pathology Chairmen (APC)

Professions Covered: Pathology

Abstract:

This study presented data from the Joint Task Force on Pathology Manpower 1980 survey on pathology manpower that was based on questionnaires sent to four groups: practicing pathologists, pathology residents, pathology training program directors, and pathologists seeking positions. The response rates to the questionnaires were judged to be highly satisfactory for all four groups. The conclusions presented concerning present and future needs in pathology were based on responses of 42.1% of the 9,565 practicing pathologists queried (Group I). The results were analyzed on a regional basis as well as on a national basis. The Group I results were then extrapolated to include two different groups of pathologists: Group II, all pathologists originally surveyed (9,565); and Group III, all nonresident pathologists (10,903). Group II estimates are the most conservative, while Group III are the most liberal. The results, expressed as number of full-time equivalent pathologists that pertain to current (1980) and projected needs (through 1989) are presented in the following table. The authors warn that this assessment depended on a number of technical and demographic trends remaining consistent. The article also presented trends based on the comparison of this survey with two previous surveys in 1975 and 1978.

Assumptions/Underlying Factors:

Full-time Equivalent (4)
Practice Patterns (3)

Table 1. Existing and Projected Need for Pathologists, 1980-1989*

Group	Sample Size	Need for Pathologists		
		1980	1980-84 (Projected)	1985-89 (Projected)
I	3832	307**	725	822
II	9565	730	1810	2045
III***	10903	831	2062	2339

*Results expressed as numbers of FTE pathologists; 1980 data represent positions open at time of survey; 1980-84 and 1985-89 data represent anticipated needs.

**Includes 26 part-time pathologists; does not include 172 full-time and 21 part-time pathologists who are needed but not budgeted.

***Represents all practicing pathologists except those in formal training programs.

Reference No. 8	**Part I and Part II. A Re-Evaluation of the Ratio of Optometrists to Population in the United States in the Light of Socio-Economic Trends in Health Care**

Author(s): Birchard, Clifton H. and Elliot, Theodore F.

Publication Information: American Journal of Optometry and the Archives of the American Academy of Optometry, Vol. 44 (January 1967), No. 1, pp. 3-20--Part I, Vol. 44 (February 1967)--Part II

Sponsor: None identified

Professions Covered: Optometry

Abstract:

This study re-evaluated the optometrists-to-population ratio in the United States under the assumption that a National Health Plan would be implemented during the period of 1970-1980. Birchard and Elliot evaluated the 1966 U.S. optometrists-to-population ratio of 1:12,000 to be "adequate". The basis of this evaluation was that U.S. optometrists did not appear to have a "lack" of patients and that many optometrists were "booked in advance". It was also concluded that the ratio of 1:12,000 in the armed forces was "far from adequate," based on the observation that optometrists in the armed forces were unable to provide care for all military personnel and their families and that many military personnel seek vision care from civilian practitioners.

Assumptions/Underlying Factors:

Practice Patterns (3)

Reference No. 9	**Estimates of Physician Requirements for 1990 for the Specialties of Neurology, Anesthesiology, Nuclear Medicine, Pathology, Physical Medicine and Rehabilitation, and Radiology**
Author(s):	Bowman, Marjorie A., MD, MPA; Katzoff, Jerald M.; Garrison, Louis P., M. PhD; and Wills, John, PhD
Publication Information:	Journal of the American Medical Association (JAMA), Vol. 250, No. 19 (November 18, 1983), pp. 2623-2627
Sponsor:	U.S. Department of Health and Human Services, Public Health Service, Health Resources Administration, Office of Graduate Medical Education
Professions Covered:	Anesthesiology; Neurology; Nuclear Medicine; Pathology; Physical Medicine and Rehabilitation, Radiology

Abstract:

This study updated the Graduate Medical Education National Advisory Committee's (GMENAC's) physician manpower requirement estimates for the specialty areas of anesthesiology, neurology, nuclear medicine, pathology, physical medicine and rehabilitation, and radiology. The previous estimates were based on literature reviews. The Batelle Human Affairs Research Center was contracted to complete this work. Using GMENAC's adjusted needs-based model and related methodology (see abstract on GMENAC Report) the projected manpower requirements (includes patient and nonpatient services) for 1990 in the six specialty areas were as follows: anesthesiology - 22,143 (full-time equivalents (FTEs); neurology - 8,367; nuclear medicine - 4,287; pathology - 15,913; physical medicine and rehabilitation - 4,060 physiatrists; and, radiology - 21,707 (DR - 19,181; TR - 2,526). These estimates revised the requirements presented in the GMENAC report. Two reports provide more detail on this study: "Physician Requirements-1990: For Neurology," and "Physician Requirement-1990 For Five Hospital-Based Specialties." (See GMENAC Studies and Critiques bibliography.) The following table presents an updated version of the health manpower requirements for 1990, the ratio percentage of projected supply to estimated requirements, and surpluses (shortages) for 34 specialties.

Assumptions/Underlying Factors:

Prevalence/Incidence of Disease Conditions (A)(1/3)
Consideration of Selected Disease Conditions (B)(2)
Requirements for Preventive Care (D)(3)
Quality of Care (E)(3)
Changing Definitions of Health (F)(3)
Utilization Rates (G)(1/3)
Time Required to Produce Services or Visits (H)(1/3)
Case Loads Per Health Professional (I)(1/3)
Task Delegation (K)1/3)
Setting of Care (M)(1/3)
Role Definition of Health Professional (N)(1/3)
Patient Subpopulations (O)(1)
Health Condition (U)(1/3)
Type of Service (W)(1/3)
Geographic Location (X)(1/(3)
Physician Density (Y)(1/3)

TABLE 1. Estimated Number of Physicians required by Speciality, United States, 1990

	Requirements
Shortages	
01 Child psychiatry	9,000
02 Physical medicine and rehabilitation	4,050
03 Emergency medicine	13,500
04 Preventive medicine	7,300
05 General psychiatry	38,500
Near balance	
Therapeutic radiology	2,550
Anesthesiology	22,150
Hematology/oncology-internal medicine	9,000
Dermatology	6,950
Gastroenterology-internal medicine	6,500
Osteopathic general practice	22,750
Family practice	61,300
General internal medicine	70,250
Otolaryngology	8,000
Pathology	15,900
Neurology	8,350
General pediatrics and subspecialties	36,400
Surpluses	
Urology	7,700
Diagnostic radiology	19,200
Orthopedic surgery	15,100
Ophthalmology	11,600
Thoracic surgery	2,050
Infectious diseases-internal medicine	2,250
Obstetrics-gynocology	24,000
Plastic surgery	2,700
Allergy/immunology-internal medicine	2,050
General surgery	23,500
Nephrology-internal medicine	2,750
Rheumatology-internal medicine	1,700
Cardiology-internal medicine	7,750
Endocrinology-internal medicine	2,050
Neurosurgery	2,650
Pulmonary-internal medicine	3,600
Nuclear medicine	4,300

Reference No. 10	Alabama's Physician Shortage - An Estimate of Its Size and Distribution by County and Specialty Groups

Author(s): Bridgers, William F., M.D.

Publication Information: Alabama Journal of Medical Sciences, Vol. 12, No. 3 (1975), pp. 280-294

Sponsor: University of Alabama in Birmingham, The Medical Center

Professions Covered: Access Medicine (General and Family Practitioning, General Internal Medicine, Pediatricians, and OB/GYN); Consultant Medicine (Surgery, Specialty Internal Medicine, Psychiatry, Neurologists); Professional Service Medicine (Radiology, Pathology, Anesthesiology, and Rehabilitative Medicine)

Abstract:

Dr. Bridgers presented three methodologies for estimating the need for physicians in the State of Alabama on a county-by-county basis. The most suitable methodology appeared to be a demand/productivity methodology that incorporated an idealized physician/specialist mix of 11:7:2 corresponding to access, consultant and professional service physicians respectively. Dr. Bridgers expressed that calculations were more meaningful at a broader level such that a ratio of 11:9 (55%:45%) of total access physicians to all others as a group should be used. The analysis first addressed the requirements for access physicians by geographic region. It was assumed that all primary care in rural areas was provided by general or family practitioners (GP/FP). To determine the number of family or general practitioners required per population unit in rural areas, it was assumed that a GP/FP could see 33 patients per day, 5 days a week, 48 weeks per year and that each patient will average 4 visits per year. These figures estimate that each GP/FP could provide care for 1,980 population, or approximately 1 GP/FP for every 2,000 population in a rural setting. Estimates for GP/FP requirements in an urban setting were based on the assumption that half of the primary care for these settings is provided by other access physicians such that the GP/FP requirement for the urban portion of each county's population is 1 per 4,000. The total number of access physicians required was calculated by adding an additional access physician for each 4,000 of urban population. The total number of access physicians required for Alabama was estimated to be 1,735. Based on this figure, and the idealized physician/specialist mix ratio, a statewide total of 1,426 for all other physicians as a group are required; 1,110 representing consultant physicians and 310 professional service physicians. Dr. Bridgers further indicated that these estimates were solely reasonable approximations and that the analysis was not designed to yield estimates for each separate specialty. Bridgers used these figures to approximate a statewide goal of 1 physician per 1,000 population.

Assumptions/Underlying Factors:

Utilization Rates (G)(3)
Case Leads Per Health Professional (I)(3)
Role Definition of Health Professional (I)(3)
Geographic Location (X)(1)

Reference No. 11	Pediatric Manpower Needs: Can They Be Met?

Author(s): Burnett, Robert D., M.D., F.A.A.P.

Publication Information: Pediatric Clinics of North America; Vol. 16, No. 4 (November 1969), pp. 781-791.

Sponsor: American Academy of Pediatrics, Council on Pediatric Practice

Professions Covered: Pediatricians

Abstract:

This study addressed the 1980 pediatrician requirements for providing idealized preventive child care, as well as total child care, which includes treating illnesses. Burnett calculated need-based pediatrician requirements by estimating the total need for well-child preventive visits for the projected 1980 population 17 years old and under (76 m children). The 100 million annual total preventive care visits estimation was reduced: 7% by the assumption that all patients do not obtained health care from pediatric practitioners; an additional 3% along the assumption that one-fifth of pediatric practitioners were in training, thus providing three million preventive visits annually; and an additional 20% assuming an 80% utilization rate by the population in general. Based on the data that 72 million well-care visits were required and that a pediatric practitioner performs 2,200 well-care visits annually, 33,000 pediatricians were needed by 1980. Burnett further assumes that by 1980, family practitioners would provide child care equivalent to 4,000 pediatricians, reducing the total number of pediatricians required to 29,000. Burnett considered this a feasible estimate when adding the time required for illness-visit case load, if the pediatrician's present efficiency is increased 25%.

An alternative demand/productivity method of projecting pediatric manpower requirements was also presented that was based on case loads (2,700 children/pediatrician) assuming three children to a family and an average number of 900 families per pediatrician. If pediatricians increase their efficiency 25%, then there could be 3,500 children/pediatrician ratio and 21,700 pediatricians would be required by 1980. If general practitioners and pediatrician practitioners in training provide child care equivalent to 4,700 pediatricians, then a total of 17,000 pediatricians would be required by 1980.

Assumptions/Underlying Factors For Method 1:

Requirements for Preventive Care (D)(3)
Utilization Rates (G)(1/3)
Time Required to Produce Services or Visits (H)(1/3)
Task Delegation (K)(3/1)
Role Definition of Health Professional (N)(1)
Patient Subpopulations (O)(1)

Assumptions/Underlying Factors For Method 2:

Physician Productivity(1)
Increased Physician Efficiency(3)
Role Definition of Health Professionals (N)(1)

Reference No. 12	**Predicting the Need for Primary Care Specialists: The Example of a Southwestern State**
Author(s):	Chilton, Lance A., M.D.; Daitz, Benson R., M.D.; and Stehr, Donald E., M.D.
Publication Information:	Southern Medical Journal, Vol. 74, No. 9 (September 1981), pp. 1107-1111
Sponsor:	University of New Mexico, School of Medicine
Professions Covered:	Primary Care Medicine (Internal Medicine, Pediatrics, and Family and General Practition)

Abstract:

This article projected primary care practitioner needs by county in the state of New Mexico for 1990. The objective of the study was to provide information for the University of New Mexico in establishing its policy for primary care residency programs. Previously published physician/population ratios together with county population projections for 1990 determined primary care practitioner needs for 1990. The mix of primary care providers was assumed to vary with the population size of the county. The alternatives range from 42-627 depending on the manpower strategy employed.

Assumptions/Underlying Factors:

Caseloads Per Health Professional (I)(3)
Geographic Location (X)(3)

Reference No. 13 | **Dental Manpower--Estimating Resources and Requirements**

Author(s): Cole, Roger B. and Cohen, Lois K.

Publication Information: Milbank Memorial Fund Quarterly, Vol. 49 (1971), No. 3 (Part 2), pp. 29-62

Sponsor: None Identified

Professions Covered: Dentistry

Abstract:

Cole and Cohen reviewed issues relating to the U.S. dental manpower supply and demand to provide a policy base for programs designed to meet dental care needs. Per capita care demand increases which resulted from three alternative activity levels assumed for "organized care" programs in 1980 were reported in units of visits per person per year based on population projections by age and family income. Low activity assumptions relate to 2.48 visits/person/year; medium activity assumptions relate to 2.64 visits/person/year; and high activity assumptions relate to 2.82 visits/person/year. Based on 300 million dental visits provided in 1965, the three alternative 1980 levels of demand for care would be 540, 570 and 619 million visits per year respectively, ignoring the estimated shortage of 18,000 dentists in 1965. Dental manpower requirements, calculated by SRA Technologies, Inc., were derived by adding reported 1980 shortages to the 1980 supply of 113,000. The following table presents dental manpower requirements for 1980 under the three activity alternatives and assuming a 30% and 42% increase in productivity. Ratios presented in the following table were calculated using the 243.3 million population projection used by Cole and Cohen.

Assumptions/Underlying Factors:

Utilization Rates (G)(1)
Case Loads Per Health Professional (I) (1/3)
Patient Subpopulations (O)(1)

Table 1. Dental Manpower Requirements for 1980

Alternative	30% Increase In Productivity	42% Increase In Productivity
Low Activity	134,000	122,000
Medium Activity	141,000	129,000
High Activity	151,000	138,000

Reference No. 14	**Future Training Needs for Physicians, Dentists, and Nurses in Michigan: A Summary of Findings**

Author(s): Commission on the Future of Higher Education

Publication Information: No Date

Sponsor: Unavailable Information

Professions Covered: Medicine and Dentistry

Abstract:

This paper was a brief summary of the Commission's observations after reviewing materials Michigan's education programs in health professions from the Department of Management and Budget. These materials covered supply projections, estimates of long-range need for health professionals, and recommendations for balancing supply and requirements. The Commission modified the physician requirement ratio of 138 (FTE)/100,000 established by the state's Office of Health and Mental Affairs to correspond to the current need and supply (171 (FTE)/100,000). Calculations for required enrollment levels were made so that first a long-term supply equilibrium was achieved and then a long-term supply equal to the State's current supply figure wasobtained. Enrollment levels were estimated using three different scenarios based on the number of new physicians coming to or remaining in Michigan. The required number of new physicians was obtained by multiplying the relevant supply ratio by the population projected for Michigan in 2010, and then assuming that 1/40th of the supply will be replaced each year due to physician death or retirement.

Assumptions used by OHMA in estimating future dental requirements (46 (FTE)/100,000) were presented, as were projected supply figures for selected years from 1980-2000. The paper also presented a discussion of the prospects for reducing the state's supply of dentists.

Assumptions/Underlying Factors:

Utilization Rates (G)(2)
Task Delegation (K)(2)
Geographic Location (X)(2)

Reference No. 15	**The Continuing Undersupply of Neurologists in the 1980s: Impressions Based on Data From Three Studies**

Author(s): Dyken, Mark L., M.D.

Publication Information: Neurology, Vol. 32 (June 1982), pp. 651-656

Sponsor: Department of Neurology, Indiana University Medical Center, Indianapolis, IN

Professions Covered: Neurology

Abstract:

This study estimated the need for neurologists in the State of Indiana and the United States in 1981. The methodology involved formal interviews with 50 private practice neurologists in Indiana to assess their recruiting activities for additional partners. Based on this information, information from physicians other than neurologists that were recruiting, and information from 10 counties without neurologists on their recognized need, Dr. Dyken estimated that 48 positions were available for clinical neurologists in 1981. Seventeen counties were actively recruiting and one neurologist was available for every 103 hospital beds or every 29,300 people. The other (represented by 6 groups) estimates for 17 counties were made on the basis of neurologists currently practicing in addition to those currently being recruited. In those groups one neurologist was available for every 167 hospital beds or every 34,356 people. The estimates of neurologists in private practice needed for the United States, based on the estimates for the State of Indiana (1/29,300-34,356 population or 1/103-167 hospital beds), were 6,476 to 7,594 (population) and 5,916 to 9,592 (acute beds). Dyken also estimated the need for all neurologists including full-time academic neurologists and VA Hospital neurologists for a total number between 8,210 and 12,080. It was further suggested that there would be an under-supply of neurologists in 1990 based on these requirement figures and the supply estimates also presented in this article.

Assumptions/Underlying Factors:

Geographic Location (X)(1)
Practice Patterns (3)

Reference No. 16	East Central Michigan Health Manpower Project - Final Report

Author(s): East Central Michigan Health Manpower Committee

Publication Information: June 1981

Sponsor: East Central Michigan Health System Agency, Inc.

Professions Covered: Primary Care Medicine; Dentistry; Nursing (RN, LPN); Psychology; Allied Health Personnel

Abstract:

The principal objective of the East Central Michigan Health Manpower Project report was to identify current and future supply and demand for health professionals in thirty-one occupational categories through 1985. The thirty-one professions were assigned to one of six major groups: Nursing; Direct Personal Care-Medical; Technical Support; Direct Personal Care-Social; Primary Care; and Dental Services. Each group had a section in the report.

Manpower requirements for direct patient and ancillary services were estimated using population and productivity ratios. A conceptual model of supply and demand was described in which population and health care needs are translated by a number of factors into a demand for services and then into the demand for personnel. Factors used by calculators varied according to the profession under study. Tables projecting cumulative growth and unmet demand show the following figures for 1985: Nursing-14,261; Direct Personal Care (Medical)-1,512; Technical Support-981; Direct Personal Care (Social)-589; Primary Care (Medical)-652; and Dental Services-754.

Assumptions/Underlying Factors:

Utilization Rates (G)(2)
Case Loads Per Health Professional (I)(2)
Task Delegation (K)(2)
Organization (L)(2)
Setting of Care (M)(2)
Type of Care (W)(2)

Reference No. 17	**Kansas: Medically Underserved Areas**

Author(s): Division of Policy and Planning, Kansas Department of Health and Environment

Publication Information: December 31, 1984

Sponsor:

Professions Covered: Medicine

Abstract:

This report was prepared as an aid to physicians with commitments to practice in underserved areas for selecting locations in which to work. Underserved areas were defined as those that have an FTE physician-to-population ratio in a specialty below the optimum criterion for that specialty and equal to or below the ratio for the state. Licensure information provide the basis for calculating ratios. Population figures came from the Kansas Department of Health and Environment estimates of population in 1984 and 1985. Ratios are based on the FBPR (Florida Baseline Physician Ratios) and provide the standard for Kansas in Health manpower planning. An FTE physician-to-population ratio of 1:3000 was used to determine critically underserved areas for primary care. Ratios of one-third of optimum ratios were used for secondary and tertiary specialities. Selected optimal standards coming from different sources were presented for comparison.

The report concludes that, based on optimum ratio of 154.7 FTE physicians per 100,000 adjusted population, Kansas currently has 591 fewer physicians than needed to meet optimal standards.

Assumptions:

N/A

Reference No. 18	**The Quantity and Quality of Medicine Manpower: A Review of Medicine's Current Efforts**

Author(s): Knowles, John H., M.D.

Publication Information: Journal of Medical Education, Vol. 44 (February 1969), pp. 81-118

Sponsor: None Identified

Professions Covered: Anesthesiology; Pathology; Radiology; Urology

Abstract:

The only empirical work presented in this comprehensive review of medical manpower issues and studies were manpower requirements recommended by the leaders of physician specialty boards and organizations. Anesthesiology manpower need was projected for 1968 and 1980 to be 37,000 and 44,000 anesthesiologists. This need was based on the number of surgical operations performed in 1968 and an annual caseload of 880 cases per anesthesiologists. According to a survey of U.S. pathology reported in 1965, twice the current supply of pathologists need to be in practice by 1970 to reach the desired level of one pathologist per 3,500 hospital admissions. The National Advisory Commission on Radiation estimated a need for 20,000-25,000 radiologists by 1975. The last estimate presented suggested that there would be a need for approximately 5,000 private practice urologists in 1968.

Assumptions/Underlying Factors:

Anesthesiology:

Prevalence/Incidence of Disease Conditions (A)(1)
Case Loads Per Health Professional (I)(4)

Reference No. 19	**National Dermatology Manpower Requirements--The Experience of Prepaid Group Practices**

Author(s): Krasner, Melvin and Ramsey, David L., M.D., M.E.D.

Publication Information: Archives of Dermatology, Vol. 113 (July 1977), pp. 903-905

Sponsor: Department of Health, Education and Welfare, Health Resources Administration, Bureau of Health Manpower, Division of Medicine (Contract #231-75-0021)

Professions Covered: Dermatology

Abstract:

This article reported the results of a 1976 American Academy of Dermatology Manpower Study survey of dermatologic staffing patterns of 10 major prepaid group health plans as part of an assessment of the need for and availability of U.S. dermotologic care. Dermatologist to population ratios were estimated using an HMO-based methodology. Information was gathered from 10 prepaid group health plans across the country; data such as information on the number of enrollees, number of dermatologic visits, the number and types of auxillary personnel and related subjects were collected. The number of full-time equivalent dermatologists per 100,000 enrollees was calculated based on 220 days per year and seven hours per day. The extreme estimates were omitted and a mean of 2.5 dermatologists per 100,000 enrollees was obtained. The average was then weighted based on the number of enrollees in each plan or 2.8 dermatologists per 100,000 enrollees. To generalize the prepaid group health plan experience to the nation as a whole, an adjustment of 0.4 dermatologists per 100,000 population was made based on a 0.3 ace-income factor to account for age and income differences between the plan enrollees and a 0.1 productivity factor to offset the greater productivity realized in group practices. Based on the 2.8 weighted average, the national need would be 3.2 dermatologists per 100,000 population. Reference was made to two serious limitations for extrapolating prepaid group health plan data for national planning: (1) staffing pattern variations, and (2) prepaid group health plans were a static reference point in that they represent dermatology practice characteristics unique to that point in time.

Assumptions/Underlying Factors:

HMO Staffing Patterns

Reference No. 20	**Manpower Needs by Speciality**

Author(s): Mason, Henry R., M.P.H.

Publication Information: Journal of the American Medical Association, Vol. 219, No. 12 (March 20, 1972), pp. 1621-1626.

Sponsor: American Medical Association

Professions Covered: Anesthesiology, Dermatology, General Surgery, Internal Medicine, Neurology, Neurosurgery, Obstetrics-Gynecology, Ophthalmology, Orthopedics, Otolaryngology, Pathology, Pediatrics, Plastic Surgery, Psychiatry, Physiatrics, Radiology, Urology

Abstract:

Mason presented data on six large prepaid group plans in 1970, including membership enrollment, age distribution of enrollees, and the optimum physician-population ratios designated by each group. Each group arrived at the optimum physician-population ratio "in a pragmatic manner," considering the demands of members to determine additional specialists needed, "all within the framework of efficient management principles and good medical services." The average physician-population ratio for the six groups was 1:1,061. Mason calculated the optimum physician-population ratios for 18 specialties derived by comparing the number of specialists employed by each group to the number of members served by the group. Several factors were presented concerning the "cautious" use of these ratios: (1) special conditions existing in the geographical area serviced by the group could affect the manpower requirements of each group such as task delegation and the degree of "self-containment" of the plan; (2) the employment specialty of internists and general surgeons was related to the number of related subspecialists employed within each plan; and (3) only membership of one prepaid group, the Health Insurance Plan of Greater New York, was representative of the age distribution of the total U.S. population, the critical concern being the percentage of members over 65 years of age.

Mason further suggested that the health manpower planning groups of each State could compare the specialist-to-population ratios of their states with other states for measuring the need of specialists in individual states. Mason prefered the median ratio as the "best standard" to be used by states for evaluating their gross needs in each specialty. Comparisons of state data should facilitate the identification of the quantity and quality of local shortages or surpluses.

Assumptions/Underlying Factors:

HMO staffing patterns.

Reference No. 21	**Development of Revised Criteria for Designating Shortage Areas for Vision Care, Foot Care, Pharmacy, and Veterinary Care Health Professionals--Final Report**

Author(s): Mathematica Policy Research, Inc.

Publication Information: October 6, 1983

Sponsor: DHHS-Health Resources and Services Administration, Bureau of Health Professions, Division of Health Professions Analysis

Professions Covered: Optometry/Opthamalogy, Podiatry, Pharmacy, Veterinary Medicine

Abstract:

The purpose of this report was to present a review and revisions of criteria for designating shortage areas for vision care, foot care, pharmacy and veterinary care professionals. Current criteria were reviewed in light of new data. Measures of units of service used to estimate requirements were reviewed, along with substitution relationships among providers of the same service, to arrive at new supply measures. Analysis of utilization data yielded alternative criteria. These alternative criteria included modifications to current criteria without substantially changing methodology; new methods for measuring utilization-based criteria to arrive at alternatives; need-based criteria incorporating adjustments to account for unmet need for care, and; demand-based criteria that modified the utilization-based criteria to account for unmet need. The report also proposed revised approaches for identifying and categorizing shortages. In a discussion of the framework and methodology for designating shortage areas, current criteria were summarized and alternatives and possible modifications were presented. Alternative approaches for measuring requirements and supply to signal shortages were also discussed. The following table presents a summary of the shortage standards for alternative HMSA criteria.

Assumptions/Underlying Factors:

Utilization (9)(2)
Case Loads Per Health Professional (I)(2)
Role Definition (substitution relationships) (N)(2)
Household/Individual Demographics (T)(2)
Geographic Location (X)(2)

TABLE 1

SUMMARY OF SHORTAGE STANDARDS FOR ALTERNATIVE HMSA CRITERIA

Type of Practitioner	Current Shortage Standard[a]	Alternative Shortage Standards
Vision Care	Estimated requirement for optometric visits - Estimated Supply of optometric visits $\geq$ 1,500 ($\geq$ 0.5 FTE)	Estimated requirement for non medical, nonsurgical/total vision care visits - Estimated supply of nonmedical, nonsurgical/total vision care visits $\geq$ 1,800 ($\geq$ 1.0 FTE)
Foot Care	Population: Foot Care Practitioner Ratio $\geq$ 28,000:1 and Population/28,000 - Estimated Supply of foot care practitioners $\geq$ 0.5	Estimated requirement for foot care visits - Estimates Supply of foot care visits $\geq$ 4,900 ($\geq$ 1.0 FTE)
Pharmacy Care	Estimated Requirement for pharmacists - Estimated supply of pharmacists $\geq$ 0.5 FTE	Estimated requirement for phar macists - Estimated Supply of pharmacists $\geq$ 1.0 FTE
Veterinary Care	VLU: Food Animal Veterinarian ratio $\geq$ 10,000:1 and VLU/10,000 - Estimated supply of food animal veterinarians $\geq$ 0.5	Estimated requirement for food animal veterinarians - Estimated supply of food animal veterin arians $\geq$ 1.0 FTE

[a]See Federal Register, November 17, 1980.

Reference No. 22	Manpower Goals in American Surgery

Author(s): Moore, Francis D., M.D.

Publication Information: Annals of Surgery, Volume 184, No. 2 (August 1976)

Sponsor: None Identified

Professions Covered: Total Surgical specialties; General Surgery; Obstetrics and Gynecology; Neurosurgery; Opthalmology; Orthopedics; Otolaryngology; Plastic Surgery; Thoracic Surgery; Urology; Colon and Rectal Surgery; Pathology, Anesthesiology; Internal Medicine

Abstract:

The purpose of this study was to establish specific manpower goals for surgery in view of social and economic pressures existing in 1976. Surgical manpower goals were defined as the optimal number of U.S. board-certified surgeons over a period of time, and the residency training required to produce these numbers. Moore then outlined the upward and downward social and economic pressures for adjusting the number of surgical manpower. He then recommended that a manpower goal should be set that achieves a growth of the surgeon/population ratio at a rate of 1% each 5 years. Table I presents the manpower goals for surgical specialties for the time period 1972-2012. For the specialties of internal medicines, anesthesiology and pathology, the 1% increase in the population ratio each 5 years did not appear to be adequate. Therefore, a 20% growth in these specialty to population ratios over the next 25-30 years were established as goals. Table II presents these alternative manpower goals.

Assumptions/Underlying Factors:

Trends in Surgical Manpower Supply (3)

Table 1. Manpower Goals In the Specialties*

Year	All	GS	OB/GYN	NS	OPTH	ORTH	OTO	PS	TS
72-77	26.39	7.22	5.78	0.821	3.30	3.52	2.00	0.543	1.21
77-82	26.65	7.29	5.84	0.829	3.33	3.56	2.02	0.548	1.22
82-87	26.92	7.37	5.90	0.838	3.37	3.60	2.04	0.554	1.23
87-92	27.18	7.44	5.96	0.846	3.40	3.63	2.06	0.559	1.25
97-02	27.73	7.59	6.07	0.863	3.47	3.70	2.10	0.571	1.27
02-07	28.00	7.67	6.13	0.872	3.50	3.74	2.12	0.577	1.28
07-12	28.29	7.74	6.20	0.880	3.54	3.78	2.14	0.582	1.30

UROL	CRS
1.82	0.15
1.84	0.15
1.86	0.153
1.88	0.155
1.90	0.156
1.92	0.158
1.94	0.160
1.96	0.161

*Certification rate required for goal achievement: %1 per 5 years growth in population ratio. All data are corrected for population and expressed "per 100,000 population."

Table 2. Alternative Manpower Goals in Pathology, Anesthesiology and Internal Medicine* (per 100,000 population)

Year	PATH	ANES	IM
1972-77	4.10	2.57	9.56
1977-82	4.51	2.83	10.52
1982-87	4.78	3.00	11.15
1987-92	4.97	3.12	11.60
1992-97	5.02	3.15	11.72
1997-02	5.07	3.18	11.83

*Goals based on a 20% increase in population ratios by 1992.

Reference No. 23	An Analysis of Current and Future Physician Supply and Requirements in New York State

Author(s): New York State Education Department;
The University of the State of New York

Publication Information: The University of the State of New York, December 1983

Sponsor: Board of Regents, The University of the State of New York

Professions Covered: Primary Care (Family Practice, General Practice, Internal Medicine, Pediatrics, OB/GYN, and Emergency Medicine); Surgical Specialists (General Surgery, Ophthalmology, Otolaryngology, Thoracic Surgery, Orthopedic Surgery, Plastic Surgery, Urologic Surgery, General Urology, and Colon-Rectal Surgery); Medical (Internal Medicine Sub-Specialties, Psychiatry, Neurology, Allergy, Dermatology, Allergy and Immunology, and Physical Medicine & Rehabilitation); Indirect Care (Anesthesiology, Pathology, Radiology, Nuclear Medicine and Preventive Medicine, Other)

Abstract:

The primary objective of this study was to produce national estimates of the current and future supply and requirements of physicians in New York State by eight separate county groupings (health systems agencies) and for the entire state. A demand/productivity method estimated physician requirements for four separate physician groupings including primary care, surgical, indirect care, and medical specialists. The following figure presents the four major assumptions on which this methodology was based.

Indirect care specialists were estimated with a regression model containing population and the number of other physicians. The other three groups were estimated by first determining the number of physician visits needed to serve a given population. Per capita visit rates by age or age and income (for primary care physicians) were used with population projections for these estimates. Patient encounters per year by physician specialty group and practice location (non-urban, small urban, and large urban) convert total visits into physician requirements by specialty. Total non-indirect care physician requirements and population projections were then used to predict indirect care specialist requirements with the regression model.

National physician visit and productivity data from the National Health Interview Survey and the Robert Wood Johnson Foundation were assumed appropriate for the state of New York in making physician requirements projections for the years 1990 and 2000. The following table presents physician requirements for the state of New York for 1980, 1990, and 2000.

Assumptions/Underlying Factors:

Utilization Rates (G)(2)
Case Loads Per Health Professional (I)(2)
Setting of Care (M)(2)
Role Definition of Health Professionals (N)(2)
Patient Subpopulations (O)(2)
Household/Individual Demographics (T)(2)
Geographic Location (X)(2)

Figure 1. Four Major Assumptions Used in New York State Physician Requirements Methology

1) National physician visit patterns and productivity levels are appropriate for New York State;

2) Physician productivity levels will remain stable over time;

3) The existing reimbursement system will remain stabilized through the year 2000; and

4) Low income individuals will underutilize primary care specialists.

Table 1. Physician Requirements for New York State for the Years 1980, 1990, and 2000

Year	Primary Care	Surgical	Medical	Indirect Care	Total
1980	14,200	7,200	5,300	4,600	31,300
1990	14,300	7,500	5,400	4,700	31,900
2000	14,600	7,700	5,600	4,800	32,700

Reference No. 24	Primary Care Component Plan (1984-1989)

Author(s): North Central Georgia Health Systems Agency, Inc.

Publication Information: No Date

Sponsor: North Central Georgia Health Systems Agency, Inc.

Professions Covered: General and Family Medicine; Pediatrics; Internal Medicine; OB/GYN

Abstract:

The purposes of this plan were to describe the existing primary care delivery system for Area III in Georgia, analyze need for services in this area, and analyze the current primary health care system to determine how it can best meet these needs.

In the report's discussion of manpower availability, a demand-based methodology was used to project physician needs for 1989. Twenty-four county health service areas were divided into 47 planning areas to provide data on smaller regions. The number of annual office visits per person by age category was multiplied by the projected populations for 1989 in each planning area to obtain an estimate of total annual visits. The total annual visits by specialty were divided by the annual average visits per physician (taken from Profile of Medical Practices, published by the AMA). This produced the number of needed physicians in each specialty. Visits were converted into numbers of FTE physicians needed for 1989. The number of physicians in each urban planning area was adjusted based on 1980 statistics to account for physicians in nonpracticing careers (e.g., research, administration). Estimates of the number of primary care physicians needed for 1989 were: General and Family Practitioners - 587.3; Internal Medicine - 85.2; Pediatrics - 198.9; Obstetrics/Gynecology - 226.3. The remainder of this report was concerned with practice characteristics, shortages, current staffing levels, facilities, roles and quality of care.

Assumptions/Underlying Factors:

Utilization Rules (G)(2)
Demographics (T)(2)

Reference No. 25	**Ambulatory Care Plan Volume III: Primary Care Component Plan (1982-1990)**

Author(s): North Central Georgia Health Systems Agency, Inc.

Publication Information: April 28, 1982

Sponsor:

Professions Covered: In its discussion of supply-related issues, many health professions were covered. Discussion of specific future demand was restricted to medicine.

Abstract:

The purposes of this plan were to describe the existing primary care delivery system, analyze future and current need for services, determine how the system can meet these needs, and make recommendations for improvements.

Two methods were used to determine future demand for physicians: a population to physician ratio model and a utilization model. The first involved multiplying the area population by a desired standard (set by professional consensus) and comparing this demand with the year's supply. Supply figures were obtained by subtracting physicians over aged 70 in a given year from the number in the area for that year. The following assumptions were applied to the model: physicians enter and leave the population at an equal rate; demand was dependent on changes in the size of the population; a predetermined standard dictates the appropriate number of physicians; growth of the population had no independent effect on physician supply; and there were no variations in population densities necessitating a specific type of manpower. The study used a ratio of 2500:1.

The second method was a utilization model that determined supply by subtracting physicians over 70 and those who might die (based on death rates specified in the report) from the total. Assumptions were that primary care physicians have private practices and specific specialties; that all physicians were considered to retire at age 70; productivity was based on solo practice; patient visits were the unit of measurement for the utilization ratio; demand (not need) was the basis of measuring requirements; population characteristics are homogeneous; and physicians will leave and enter the population at an equal rate. (Cont'd)

Demand projections for both models were listed by counties. Practice and supply characteristics were examined in the report to determine shortages for a variety of health professionals. Facilities, services, and cost-related issues were also addressed.

Assumptions:

See the above abstract for details on assumptions used for models 1 and 2.

Uitlization rates (G) (Model 2) (4)
Case loads per health professional (I) (Model 2) (4)

Reference No. 26

Update on the Analysis of the Need for Pediatric Surgeons in the United States

Author(s): O'Neill, James A. and Vander Zwagg, Roger

Publication Information: Journal of Pediatric Surgery, Vol. 15, No. 6 (December 1980), pp. 918-924

Sponsor: Department of Pediatric Surgery, Vanderbilt University School of Medicine/Department of Community Medicine, University of Tennessee College of Medicine

Professions Covered: Pediatric Surgery

Abstract:

This study grew out of the manpower arm of the Study on Surgical Services for the United States (SOSSUS) which was organized in 1972 to evaluate the need for various types of certified surgeons. The American Pediatric Surgical Association initiated its own analysis in 1975 and this document reports on the results from the 1980 update of this study. The purpose was to determine the existing supply and distribution of pediatric surgeons, the approximate number needed and where, and to develop a method of predicting the number of training programs and trainee output required to satisfy estimated manpower needs.

Area questionnaires were used to determine manpower requirements. A sample of pediatric surgeons was surveyed to determine need, with one to two from each SMSA with a population greater than 200,000 providing information from their area concerning current supply and need. The results indicated a need for 350 to 400 pediatric surgeons. No specific year was given for this projection but is appears to be 1980. The higher figure was indicated if individuals included urology, cardiac surgery or some types of plastic surgery in their range of clinical practice while the lower figure held for those who might do general and thoracic surgery exclusive of cardiac surgery.

Assumptions/Underlying Factors:

Role Definition of Health Professionals (N)(3)

Reference No. 27	Planning for Physician Requirements and Supply in Michigan

Author(s): Office of Health and Medical Affairs
Department of Management and Budget, State of Michigan

Publication Information: May 1981

Sponsor: Office of Health and Medical Affairs

Professions Covered: Medicine (report does not address speciality distribution in detail).

Abstract:

The purpose of this document was to provide accurate assessments of future physician requirements and supply to help foster public policy decisions that will balance supply with the health care needs of Michigan's citizens. This report used HMO staffing patterns to develop a numerical goal for physician requirements in 1985 and 1990 by making adjustments for: economies of scale; differences in age composition between HMOs and the general population; out-of-plan usage; differences in health status (specifically, greater need for psychiatrists by the non-HMO population); and nonpatient care requirements. This methodology assumed improvement in the efficiency of the health care delivery system to achieve an equivalent level of performance of the prepaid groups examined for this study. The numerical physician requirements goal under this methodology was 138/100,000 population.

In addition to the prepaid group practice plans used as a model for the methodology described above, this report discussed both need or adjusted need-based models and demand-productivity methodologies, including the GMENAC (Graduate Medical Education National Advisory Committee) and the Federal Bureau of Health Professions (BHPr) models.

Data on HMOs specifically identified in the report included figures from the Group Health Cooperative of Puget Sound, the Harvard Health Plan, Health Insurance Plan of Greater New York, and the Temple Health Plan.

Assumptions/Underlying Factors:

Utilization Rates (G)(2)
Household/Individual Demographics (T)(2)
Health Status (U)(2)
Geographic Location (X)(2)

Reference No. 28	Doctor Shortage? It's Narrowing Down to Primary Care

Author(s): Paxton, Harry T.

Publication Information: Medical Economics, March 19, 1973, pp. 104-107

Sponsor: Medical Economics

Professions Covered: Allergy, Anesthesiology, Cardiology, Dermatology, Gastroenterology, General and Family Practice, General Surgery, Internal Medicine, Neurology, Neurosurgery, Obstetrics and Gynecology, Ophthalmology, Orthopedic Surgery, Otolaryngology, Pathology, Pediatrics, Plastic Surgery, Psychiatry, Pulmonary Disease, Radiology, Thoracic Surgery, and Urology.

Abstract:

Physician-to-population estimates for 1972 were presented based on a canvass of senior directors of national specialty boards and societies to evaluate current (1972) health manpower shortages. At least three "top men" representing each of 22 fields of physician specialties were asked to estimate the ideal physician-to-population ratio for his field to establish base lines for measuring health manpower shortages. When experts disagreed on ideal ratios, mid-range figures were used. No implicit or explicit assumptions were presented to rationalize these ideal ratios. A discussion on the outlook for health manpower in 1980 is also presented.

Assumptions/Underlying Factors:

None clarified.

Table 1. "Ideal" Physician-population Ratios

Speciality	Recommended Population Per M.D.
Allergy	25,000
Anesthesiology	14,000
Cardiology	25,000
Dermatology	40,000
Gastroenterology	50,000
General and Family Practice	2,000
General Surgery	10,000
Internal Medicine	5,000
Neurology	60,000
Neurosurgery	100,000
Obstetrics and Gynecology	11,000
Ophthalmology	20,000
Orthopedic Surgery	25,000
Otolaryngology	25,000
Pathology	20,000
Pediatrics	10,000
Plastic Surgery	50,000
Psychiatry	10,000
Pulmonary Disease	100,000
Radiology	15,000
Thoracic Surgery	100,000
Urology	30,000

Reference No. 29	**The Need for Pediatric Surgeons as Determined by the Volume of Work and the Mode of Delivery of Surgical Care**

Author(s): Ravitch, Mark M., M.D. and Barton, Bruce A., M.S.

Publication Information: Surgery, Vol. 76, No. 5 (1974), pp. 754-763

Sponsor: Department of Surgery, Montefiore Hospital
Departments of Surgery and Biostatistics, University of Pittsburgh

Professions Covered: Pediatric Surgery

Abstract:

The purpose of this document was to determine the magnitude of the need for pediatric surgical services in terms of the incidence rates of several index conditions and whether this need was best met by achieving a certain manpower/population ratio.

The authors used raw data to calculate estimates of incidence rates of nine index conditions which they felt were critical to the specialty of pediatric surgery. They then multiplied their sum by a factor of two or three to determine the total number of cases that need the attention of a pediatric surgeon. They determined their incidence rates through the use of several raw data sources and then validated them with other studies from the literature. Since their estimates tended to be high as compared to those of other reports they believed their personnel requirements would be at least adequate.

They calculated that with 300 pediatric surgeons in 1985 (same number as base year 1970), each would do 110 major pediatric surgeries per year or would see 4-5 total cases per week which they thought was adequate and reasonable.

If an estimate was derived solely on a population basis (i.e., 1 pediatric surgeon per 100,000 or 200,000 population within a city) the number of pediatric surgeons needed in 1985 would be 726 or 1546. If these surgeons divided up all the survey evenly then each would see from 70 to 140 major problem conditions per year.

Assumptions/Underlying Factors:

Incidence of Disease Conditions (A)(2)
Consideration of Selected Disease Conditions (B)(2)
Caseloads per Health Professional (I)(3)

Reference No. 30 | **Ophthalmology (Eye Physician and Surgeon) Manpower Studies for the United States**

Author(s): Reinecke, Robert D., M.D.; editor

Publication Information: Ophthalmology, Vol. 85 (October 1978), pp. 1057-1134

Sponsor: American Academy of Ophthalmology

Professions Covered: Ophthalmology

Abstract:

This report summarized manpower needs for ophthalmologists by the Committee on Ophthalmological Services for the United States. The Committee estimated theoretic ophthalmology manpower needs using a medical-need based approach under the assumptions that every person who had an eye disease received optimal eye care and any person desiring an eye exam by an ophthalmologist could do so within a reasonable period of time. This method, which is similar to that of Schonfeld, estimates the number of physician hours required to treat the anticipated incidence of acute and chronic diseases. Although the specific incidence of eye disorders was unknown, best estimates were made from existing data and the most conservative figures were chosen. Data on disease prevalence is incorporated when appropriate. The Committee took into consideration the eye care incidents that they thought were appropriate for the field of ophthalmology. The Committee attempted to gather consistently the following data in each disease category: (1) the average length of time the physician spent with each patient, (2) the average number of office visits per year per disease category, and (3) an estimate of the time spent in surgery and hospital patient care by the ophthalmologist. The total medical and surgical ophthalmology hours required for the treatment of these disorders equals 32,301,400 when rounded off to the nearest 100. The Committee estimated that an ophthalmologist spends nine hours per week on administrative and continuing education responsibilities. These hours were subtracted from total work hours to calculate the hours per year an ophthalmologist was available for patient care. In 1977, the estimated numbers of ophthalmologists needed, based on 48- 40-, and 35-hours work weeks, were 16,565, 20,840, and 24,847 respectively. The Committee stated that in the year 2000, 16,565 ophthalmologists will be the minimum number needed as the U.S. population will be larger and significantly older. The under-reporting of disease incidence and prevalence was considered balanced by the fact that not all patients needing care seek care. To keep estimates conservative, no increased manpower demands due to scientific developments were projected. For each major disease category, the Committee addressed reasons an ophthalmologist should be used for treatment instead of another health professional and the potential impact of National Health Insurance on each group of patients. Recommendations and modifying factors were also discussed, as well as a comprehensive appendix on suggested readings.

Assumptions/Underlying Factors:

Prevalence of Disease Conditions (A)(1)
Consideration of Selected Disease Conditions (B)(3)
Time Required to Produce Services or Visits (H)(3)

Reference No. 31	**Technical Report No. 25: Surgery and the GMENAC Report: An Evaluation Using the CRV Approach and Rhode Island Data**

Author(s): Rhode Island Department of Health

Publication Information: September, 1982

Sponsor: Rhode Island Department of Health

Professions Covered: Surgery (General Surgery, Ophthalmology, Neurosurgery, Orthopedic Surgery, Otolaryngology, Plastic Surgery, Thoracic Surgery, Urology, OB/GYN)

Abstract:

The purpose of this report was to provide a quantitative assessment of surgical manpower requirements for Rhode Island proposed by the Graduate Medical Education National Advisory Committee (GMENAC). The report serves as a "reality test" for GMENAC's projected requirements for surgeons by comparing GMENAC's surgical parameters and projections with actual practice in Rhode Island and withnational data. It provided an opportunity for policymakers to evaluate the GMENAC studies and their implications for surgical manpower nationally and in the state. A description of the GMENAC adjusted needs-based model was contained in the report.

Requirements for surgical manpower were projected using an application of the CRV (California Relatively Value) approach to GMENAC's projected population-based use rates for specific surgical procedures. CRV values corresponded to the complexity and amount of time required for preoperative and postoperative care. It was possible to arrive at a complexity-weighted measure of workload by summing CRV values.

Surgical requirements were evaluated by speciality based on a total of 99,246 primary procedures. A total of 394 surgeons were needed as determined by this evaluation. Surgical requirements are presented for nine specialties: General Surgery (94); Neurosurgery (11); Ophthalmology (47); Orthopedic Surgery (61); Otolaryngology (32); Plastic Surgery (11); Thoracic Surgery (8); Urology (31); and Obstetrics and Gynecology (99).

Assumptions/Underlying Factors:

Utilization Rates (9)(2)
Caseloads Per Health Professional (I)(2)
GMENAC: Consideration of Selected Disease Conditions (B)(2)
Requirements for Preventive Case (D)

Reference No. 32	**Need-Based Requirements for Primary Care Physicians**

Author(s): Roddy, Pamela C., Ph.D.

Publication Information: Journal of the American Medical Association (JAMA), Vol. 243, No. 4 (January 25, 1980), pp. 355-358.

Sponsor: Department of Health, Education and Welfare (DHEW)

Professions Covered: Primary Care (Family Practitioners, General Practitioners, Pediatricians, Internists)

Abstract:

This study calculated the total number of primary care physicians (i.e. family and general practitioners, pediatricians and internists only) required for the years 1975, 1980, and 1990. Roddy used overall incidence and prevalence rates and standards of care to determine the number of total acute, chronic, and well-care visits (children only), according to age-specific population groups, required for the designated years. The actual and projected numbers of general and family practitioners, pediatricians, and internists were used to develop supply ratios between specialties. These ratios and full-time equivalent manpower standards were used to distribute the total number of visits required among the specific specialties. Pediatric care manpower requirements were calculated by dividing the distributed primary care visits by the annual productivity levels for pediatricians and family and general practitioners. The same methodology was used to determine adult care manpower requirements for internists and family and general practitioners. Primary care physician manpower requirements were also calculated assuming a 63% gain in productivity due to task delegation to physician extenders. The following table presents these manpower needs for the years 1975, 1980, and 1990.

The manpower requirements were for ambulatory care alone and no estimates were made for full-time physicians in administration, teaching and research. Dr. Roddy noted that the physician manpower requirements for acute care may be based on overall incidence rates and standards that were derived from generous patient visit estimates for acute conditions. Therefore, these requirements may overstate the actual need for care. Also, the manpower requirement estimates are based on the perception of the role of general and family practitioners in 1980. If primary care shifts from general and family practitioners to internists and pediatricians or vice versa, future manpower requirements related to the different productivity levels of these professions could be affected.

Assumptions/Underlying Factors:

Prevalence of Disease Conditions (A)(2)
Productivity Levels (visits/week/year)(2)
Task Delegation (K)(3)
Patient Subpopulations (O)(1)(child; adult)
Type of Care (W)(1)

Table 1. Comparison of Requirements for Primary Care Physicians With and Without Task Delegation

Year	With Task Delegation	Without Task Delegation
Total Primary Care		
1975	136,280	222,090
1980	148,250	241,570
1990	166,430	271,170
General and Family Practice		
1975	47,560	77,620
1980	48,990	79,960
1990	51,350	83,810
Pediatrics		
1975	26,400	43,070
1980	25,920	42,290
1990	29,200	47,640
Internal Medicine		
1975	62,320	101,400
1980	73,340	119,320
1990	85,880	139,720

Reference No. 33	**Present Status and Forecasted Growth of Institutional Pharmacy Manpower**

Author(s): Rodowskas, Christopher A. and Dickson, W. Michael

Publication Information: American Journal of Hospital Pharmacy, Vol. 30 (December 1973), pp. 1136-1142

Sponsor: National Institutes of Health, Bureau of Health Manpower Education (Contract No. NO1-MI-1478)

Professions Covered: Pharmacy

Abstract:

The purpose of this document was to examine the composition of hospital pharmacy manpower and project needs for the future. Three methods were presented: one that used external variables (population and drug demand) as predictors, one treated existing data statistically, and a third that involved developing an idealized model based on economic growth.

The first method used 1970 census figures and the reported number of pharmacists for that year to forecast requirements from 1970 to 1985. In the second method, several techniques for forecasting (not described in this document, but including linear and nonlinear methodologies) were used to arrive at projections of historical data. The idealized model is based on drug demand and the pharmacists' changing role with results adjusted for anticipated increases in efficacy transfer of functions from other health professionals.

Net hospital pharmacy manpower projections for 1985 (related to anticipated population changes) were: 12,800 (low population); 13,900 (high population); 27,900 (drug demand based)

Idealized institutional pharmacy manpower development projections for the years 1970 and 2000 were 32,000 and 172,000 respectively.

Assumptions/Underlying Factors:

Utilization (G)(2)
Role Definition of Health Professionals (N)(4)

Reference No. 34 | **Pharmacy Manpower: Current Status and Future Requirements**

Author(s): Rodowskas, Christopher A., Jr., Ph.D.

Publication Information: Medical Marketing and Media, Vol. 8, No. 7 (July 1973) pp. 18-30

Sponsor: American Association of Colleges of Pharmacy

Professions Covered: Registered Pharmacy

Abstract:

This article discussed preliminary estimates of the human resources required tomeet current and future demands for pharmaceutical services. It also provided a statistical profile of pharmacy manpower information by state.

The preliminary estimate for pharmaceutical servicess was a supply type of projection. Pharmacist manpower requirements projections were based on the current ratio of 63 per 100,000 population and the all-time high of 68 per 100,000 population. The other approach used to estimate pharmaceutical services needs was based on a forecast of drug demand. Drug demand, expressed in billions of dollars, potentially rises at a rate forecasted by the McGraw-Hill Economics Department. The pharmacy manpower requirements were projected to rise at the same rate.

The breakdown of pharmacists required per 100,000 population is found in Table 1 of this document.

Assumptions/Underlying Factors:

Utilization Rates (G)(1)
Case Loads per Health Professional (I)(1)

Table 1. Pharmacy Manpower and Status and Projections Based Upon Drug Demand, 1970-1985*

Year	Drug Demand ($ Billion)	Pharmacy Manpower Requirements (Thousands)
1970	6.7**	128.5**
1975	9.0	172.6
1980	12.5	239.7
1985	17.0	326.0

*Based upon current NABP statistics and drug demand forecast of the McGraw-Hill Economics Department
**Actual

Reference No. 35	**A Method of Assessing Dental Manpower Need in a Low Income Area of Philadelphia**

Author(s): Rosenbaum, Jack; Speicher, Kirk A.; Tannenbaum, Kenneth A.; and, Mumma, Richard D., Jr.

Publication Information: Public Health Reports, Vol. 90, No. 3 (May-June 1975), pp. 257-261

Sponsor: Division of Dental Health, Bureau of Health Manpower Education, Department of Health, Education and Welfare

Professions Covered: Dentistry

Abstract:

This study presented a methodology to evaluate the need for additional dentists based on anticipated use and then applies it to a low-income area of Philadelphia, PA. Anticipated demand was estimated as a function of age, family income, and racial characteristics of the population by census tract. The potential dental resources were estimated by the number of potential patient visits per year that local dentists reported (both present utilization and anticipated changes in utilization). Unmet demand was calculated as the difference between total anticipated demand and potential patient visits. The productivity of dentists (3,015 average number of patient visits to a dentist with 1 assistant), based on the number of full-time auxiliary personnel employed (ADA Survey, 1965), was used to convert the unmet demand (patient visits/year) to the number of additional dentists needed. On the basis of this model seven more dentists, in addition to the 16 currently practicing in the area, were required to serve the area's population of 66,764.

Assumptions/Underlying Factors:

Utilization Rates (G)(3/1)
Case Loads Per Health Professional (I)(1)
Patient Subpopulations (O)(1)
Household/Individual Demographics (T)(1)
Geographic Location (X)(1)
Standards of Dental Care (3)
Standards of Dentist Productivity (2)

Reference No. 36	Numbers of Physicians Required for Primary Medical Care

Author(s): Schonfeld, Hyman K., Dr. PH; Heston, Jean F., MPH; and Falk, Isidore S., Ph.D.

Publication Information: The New England Journal of Medicine, Vol. 236, No. 11 (March 16, 1972), pp. 571-576

Sponsor: Department of Health, Education and Welfare; Yale University School of Medicine

Professions Covered: Primary Care Medicine (Pediatrics, Internal Medicine)

Abstract:

This study reported estimates on the numbers of pediatricians and internists required to provide "good" primary medical care. These estimates were based on professional opinion concerning services needed for "good" medical care and on incidence and prevalence estimates of conditions requiring care. The total amount of service time required for primary-physician care was calculated from the number of acute and chronic conditions that physician attention was sought (National Center for Health Statistics, June 1967-July 1985) and the average amount of time required for physician care (physician interview data). The total amount of service time was converted to manpower estimates by dividing by 2,227 hours for pediatricians and 2,198 hours for internists. Chronic conditions included both "first-year" and "carry-over" care. Estimates for the number of physicians required for chronic condition care were adjusted based on the assumption of simultaneous care for coexisting chronic conditions. Estimates were also prepared for well-child care for children under 17 years of age and for consultations with expecting mothers. Within the scope of the study, primary physician care excluded most mental and obstetric conditions, dental care, and routine physicals for adults. This study estimated a need for approximately 133 physicians per 100,000 persons in the population (pediatricians - 376/100,000; internists - 96/100,000)

Assumptions/Underlying Factors:

Prevalence/Incidence of Disease Conditions (A)(2)
Consideration of Selected Disease Conditions (B)(3)
Requirements for Preventive Care (D)(3)
Time Required to Produce Services or Visits (H)(2)
Case Loads per Health Professional (I)(2)
Role Definition of Health Professional (N)(3)
Patient Subpopulations (O)(1)
Type of Health Condition (W)(1)

Reference No. 37	**A Method of Estimating Physician Requirements**

Author(s): Scitovsky, Anne A. and McCall, Nelda

Publication Information: Milbank Memorial Fund Quarterly, Health and Society, Vol. 54, No. 3 (Summer 1976), pp. 299-320

Sponsor: National Center for Health Services Research

Professions Covered: General Practice, Allergy, Dermatology, Internal Medicine, Pediatrics, General Surgery, Neurological Surgery, Obstetrics and Gynecology, Ophthalmology, Orthopedic Surgery, Otolaryngology, Plastic Surgery, Urology, Radiology, Neurology

Abstract:

This study presented an HMO-based methodology for estimating physician requirements for the United States. This methodology was based on 1965 and 1966 physician utilization rates for two groups covered by comprehensive prepaid medical plans that provided unlimited first-dollar coverage for the majority of physician services in and out of the hospital. Physician and outpatient ancillary services were provided by the Palo Alto Medical Clinic (PAMC), which was a multispecialty group practice providing 85 percent of their services on a fee-for-service basis. This method was based on the assumption that if members of a given age-sex group of the study population used "x" percent of the total number of PAMC services provided that year in a given specialty, then this group required "x" percent of the total number of PAMC physicians in that specialty that year. These physician requirements for each age-sex category and each specialty were then extrapolated to the entire U.S. population using the national age-sex distribution. These estimated requirements were then summed to give an estimate of the total number of physicians for these specialties required to give PAMC-type care to the entire U.S. population (290,000 physicians required in 1966 or 148 per 100,000 population).

The authors discussed assumptions in their calculations that may make their estimates of physician requirements relatively high that are presented in the following figure.

Assumptions/Underlying Factors:

HMO Staffing Patterns (1)

Figure 1. Assumptions Considered to Cause Physician Requirements Estimates to be Relatively High

- The study population received the same "mix" of physician services as the entire PAMC population may further reduce estimated requirement by up to 20 percent;
- The reasons the study population sought physician services were the same as for the U.S. population as a whole;
- The entire U.S. population would have used the same amount and type of physician services as the study population that may be unrealistic for 2 major reasons: (1) the liberal benefits of the plans may have attracted a disproportionate share of high users; and (2) the study population consisted of white, middle-class persons, a large percentage of which were highly educated and presumably sophisticated medical care users; and,
- The differences between the physician-utilization rates of study members 65 years and older are notably significant when compared to other group rates for the 65 and older age group. According to this study's estimates, 70,000 physicians would be required to meet the needs of this age group. Whereas estimates based on national data, 50,000 physicians would be required to meet the needs of the 65 years and older groups.

Reference No. 38	Health Manpower Study: Dental Manpower

Author(s): State Council of Higher Eduation for Virginia

Publication Information: A Technical Report in Support of the Virginia Plan for Higher Education; Series 5, Number 4, September 1974

Sponsor: State Council of Higher Education for Virginia

Professions Covered: Dentistry (also addressed dental hygienists, assistants and laboratory technicians)

Methodology: Demand/Productivity

Abstract:

The purpose of this report was to address dental manpower in Virginia and to estimate manpower requirements for dentists, dental hygienists, dental assistants, and dental laboratory technicians through 1990. The ultimate goal was to develop an information system for health manpower educational planning. Dental service demand estimates were based on projections of population and per capita personal income through 1990. Two series of dental manpower requirements were presented. The first set ("simple") projected demand for dental manpower based on estimated increases in dental service demand. This "simple" demand projection assumed no changes in the productivity of dentists as reported in the 1971 Survey of Dental Practice (ADA, 1971) as well as no changes in the delivery of dental services from 1970 through 1990. The second set ("productivity") of demand projections followed the same basis and assumptions as the first set except several assumptions were made on the increased productivity of dentists: (1) the increased use of dental auxilliaries will increase dentist productivity; (2) the 1980 and 1990 ratio of hygienists to assistants will be the same as in 1970; (3) 575 technicians will be required in 1980 and 865 in 1990; and (4) the number of dental care services administered by dentists in 1970, 1980 and 1990 will be 150, 200 and 275 respectively. According to these dental manpower requirements estimates (see the following table) and supply projections, the authors report a surplus of 125 dentists for 1980 and 450 for 1990 in Virginia. Population projections presented in the document were used to calculate dentists per 100,000 population.

	Projection Method			
	Simple		Productivity	
	1980	1990	1980	1990
Dentists	2875	4310	2155	2350
Hygienists	360	540	375	740
Assistants	3210	4815	3360	6620
Technicians	575	865	575	865

Underlying Factors/Assumptions:

Case Loads Per Health Professional (I)(3)
Task Delegation (K)(2/3)
Household/Individual Demographics (T)(1)
Geographic Location (X)(1)

Reference No. 39	Health Manpower Study: Primary Care Physicians

Author(s): State Council of Higher Education for Virginia

Publication Information: A Technical Report in Support of the Virginia Plan for Higher Education; Series 5, Number 7, August 1977

Sponsor: State Council of Higher Education for Virginia

Professions Covered: Primary Care Medicine (GP/FP, General Internal Medicine; General Pediatrics; Emergency Medicine)

Methodology: Demand/Productivity

Abstract:

The purpose of this study was to examine the projected demand for primary care (PC) physicians in Virginia based upon 1971 national utilization of primary care physician services. Demand, measured as the number of visits to a PC physician, was assumed to be influenced by the demographic characteristics of population age and urban-rural location. Therefore, the number of PC visits was divided into urban or rural encounters and clustered by age group. The national rate of PC visits in each category was multiplied by the projected Virginia population in each category to adjust for the demographic differences between state and national populations. The national mean number of visits per year to a PC physician was used to convert from services to the number of physicians demanded. Upper and lower limits of 10% of the projected number of PC physicians were derived into order to compensate for error. A second set of projections was determined according to the previous methodology, except for the new assumption that the national rate of urban visits would equal the rate of rural visits for Virginia. These projections are based on several additional assumptions: including the percent system of health care delivery by PC physicians would not change; and the Virginia population utilization of PC physicians was similar to that of the national population. These methodologies do not account for unmet demand. (See following table).

TABLE 1

Projected Demand for All Primary Care Physicians in Virginia for 1980, 1985, 1990, and 1995[a]

Projection Year	Projection One: Based on Both Urban and Rural Rates	Projection Two: Based on Urban Rates Only
1980		
Projected Demand	2,593	2,660
Upper Limit	2,850	2,925
Lower Limit	2,335	2,395
1985		
Projected Demand	2,766	2,836
Upper Limit	3,045	3,120
Lower Limit	2,490	2,550
1990		
Projected Demand	2,956	3,031
Upper Limit	3,250	3,335
Lower Limit	2,660	2,730
1995		
Projected Demand	3,134	3,205
Upper Limit	3,450	3,525
Lower Limit	2,820	2,885

SOURCE: Authors

NOTE: [a]Includes physicians in the Primary Care Specialties whose major professional activity involves patient care, medical teaching, administration, research, or other.

Underlying Factors/Assumptions:

Case Loads Per Health Professional (I)(2)
Household/Individual Demographics (T)(1)
Geographic Location (X)(1)

Reference No. 40	Health Manpower Study: Pharmacy Manpower

Author(s): State Council of Higher Education for Virginia

Publication Information: A Technical Report in Support of the Virginia Plan for Higher Education; Series 5, Number 3; May 1974

Sponsor: State Council of Higher Education for Virginia

Professions Covered: Pharmacy

Methodology: Demand/Productivity

Abstract:

The purpose of this study was to address issues concerning the education of pharmacists in Virginia and to estimate manpower requirements for pharmacists through 1990. Pharmacy manpower requirements for Virginia were based on projections of population and per capita personal income through 1990. The combined effects of population increases and real per capita personal income increases were estimated in order to determine the change in demand for pharmacists services. The "best" estimate of the number of pharamacists required for 1980 and 1990 were 2440 and 2850 respectively based on the following assumptions: (1) pharmacy manpower requirements are related to changes in population and per capita income; (2) there will be no changes in the delivery of pharmacy services; (3) the demand and supply of pharmacists was in balance in 1970; (4) a 22% increase in pharmacist productivity during the 1970's and a futher 22% increase in the 1980's. Based on these estimates and supply projections, a shortage of 415 pharmacists would exist in Virginia in 1980 and 465 in 1990. Population projections presented in this document were used to estimate the number of pharmacists required per 100,000 population. When the assumption concerning productivity estimates was excluded, the population projection estimated that 2,980 pharmacists would be required in 1980 and 4,250 in 1990. The former estimates were considered the "best" estimates by the authors.

Underlying Factors/Assumptions:

Productivity (H)(1)
Household/Individual Demographic (T)(1)
Geographic Location (X)(1)

Reference No. 41	**The 1984 Plan for the Health of Kansas—Manpower Section on Primary Care**

Author(s): Statewide Health Coordinating Council and Department of Health and Environment

Publication Information:

Sponsor:

Professions Covered: Medicine (primary care)

Abstract:

This paper discussed physician manpower shortages in Kansas over the last several years, and provided projections for 1986 and 1990 that show improvement in the supply of primary care physicians will be slow. Factors contributing to maldistribution and shortages were presented as were recommendations for improving availability of services. Optimum ratios were obtained from the 1982 report of the Department of Health and Environment. The following table shows projected surpluses and deficits in physician supply.

Projected Full-Time Equivalent* Physicians Per 100,000 Population, Active in Kansas, By Specialty Category, 1986 and 1990

Specialty	1986	1990	Optimum Ratios	Percent Deficit or Surplus Projected 1986	1990
Primary	64.0	70.6	73.0	12.3% Deficit	3.3% Deficit
Secondary	60.6	66.5	66.0	8.2% Deficit	0.8% Surplus
Tertiary	18.1	21.8	12.7	42.5% Surplus	71.1% Surplus
Total	142.7	158.9	151.7	5.9% Deficit	4.7% Surplus

*Projections based on average percent increase, 1978-1982.

Assumptions:

N/A

Reference No. 42	**Michigan State Health Plan 1983-1987, Volume III: Health Personnel Resources**

Author(s): Statewide Health Coordinating Council, State of Michigan

Publication Information: September 1983 (Approved June 17, 1983)

Sponsor: Statewide Health Coordinating Council, State of Michigan

Professions Covered: Medicine; Dentistry; RNs; LPNs, Nurse Anesthetics, Nurse Practitioners

Abstract:

The two central purposes of Volume III of this State Health Plan were to present a coherent health personnel policy for Michigan, and to propose resource allocations for health care that balance the State's desire for improved health with resource limitations. This involved assessing future needs for various categories of personnel (physicians, nurses, and dental health care providers), identifying distribution problems, and determining necessary changes in public and private sector policies to solve distribution and supply problems.

HMO physician requirements were used as a point of reference in analyses and recommendations to improve the supply and utilization of physicians; these requirements were adjusted for differences between the HMOs and the entire health care system (for age of the population, economies of scale, out-of-group utilization and referrals).

A modified need-based methodology was used in analyzing nurse requirements. A methodology based on relative need was applied to an existing need-based model in the context of containing costs. Requirements estimates were produced for major settings by multiplying population projections for 1990 by a ratio of beds to population, then by the average occupancy rate of population, and then by the average occupancy rate of an average number of patients per day. Data sources most frequently cited were MCHIS and ADA survey data, county statistical reports or physician licensing, and information on HMO staffing patterns. Requirements estimates for 1990 were: 180/100,000 LPNS; 480/100,000 RNS; 138/100,000 physicians; and 44.2/100,000 dentists.

Assumptions/Underlying Factors:

Requirements for Preventive Care (D)(2)
Quality of Care (E)(2)
Utilization Rates (G)(2)
Setting of Care (M)(2)
Number of Hospital Beds per Population (Z)(2)

Reference No. 43	Health Manpower Distribution in Pennsylvania

Author(s): Tokuhata, George K., DrPH, Ph.D.; Newman, Pauline, Ph.D,; Digon, Edward, MPH; Mann, Linda A., BA; Hartman, Thomas, BA; and Ramaswamy, Krishnan, MSc, MS(Hyg)

Publication Information: American Journal of Public Health, Vol. 65, No.8 (August 1975), pp 837-848

Sponsor: Pennsylvania Department of Health, Bureau of Program Evaluation

Professions Covered: Medicine; Dentistry; Dental Hygienists; RNs; LPNs; Pharmacy; Physical Therapists, Podiatry; Chiropractors; Optometry

Abstract:

The purposes of this study were to determine the overall distribution of each group of licensed health personnel in Pennsylvania, to derive a practical numerical criteria with which "relative adequacy" of personnel supply may be determined, to identify counties and minor civil divisions where the supply of health personnel may be considered "unfavorable", to analyze the pattern of personnel distribution according to the size of the population served, to determine how various health professions are geographically correlated with one another, and to evaluate certain characteristics of physicians.

Manpower requirements ratios were calculated as approximately midway between the highest and lowest county ratio in Pennsylvania. The ratios were derived merely as a means of comparing different areas of the state to others. Ratios were defined in terms of an "unfavorable" supply of health care personnel in relation to the size of the population. These ratios are presented in the following table.

Assumptions/Underlying Factors:

Utilization Rates (G)(1)

Table 1. Manpower Requirement Ratios for Health Professionals in Pennsylvania

Health Personnel	"Unfavorable" Population to Health Personnel Ratio
Physicians	1,500 or more persons/physician
Dentists	3,000 or more persons/dentist
Dental Hygienists	20,000 or more persons/Hygienist
Registered nurses	200 or more persons/nurse
Practical nurses	500 or more persons/nurse
Pharmacists	3,000 or more persons/pharmacist
Physical therapists	30,000 or more persons/therapist
Podiatrists	40,000 or more persons/podiatrist
Chiropractors	20,000 or more persons/chiropractor
Optometrists	15,000 or more persons/optometrist

Reference No. 44	**Future Requirements for and Supply of Ophthalmologists**

Author(s): Trobe, Jonathan D., MD and Kilpatrick, Jerry E., PhD

Publication Information: Archives of Ophthalmology, Vol. 100 (January 1982), pp. 61-65

Sponsor: Veterans Administration Medical Center/Department of Ophthalmology, College of Medicine and Health Systems Research Divisions, University of Florida

Professions Covered: Ophthalmologists

Abstract:

The primary objective of the study was to produce projections of national requirements and supply for ophthalmologists. A utilization-based approach was used, calculating the number of ophthalmologists needed to provide services based on available data on ophthalmology services dispensed in a base year.

The projected requirement for ophthalmologists in a given year was calculated by identifying the services expected to be consumed for each diagnostic entity, multiplying these by the average number of hours an ophthalmologist will devote to providing them, summing these hours over all diagnoses, and dividing by the average number of hours per year a practitioner was expected to devote to direct patient care. The services to be consumed equals the 1976 visit rate multiplied by the expected population growth from 1976 to 1990.

The projected requirements for 1990 were 7,001 ophthalmologists working a 37.35 hour week of direct patient care or 8,716 working a 30 hour week. The latter assumption more closely approximated the data from the log diaries of a sample of ophthalmologists from the 1975 Study of Surgical Services for the U.S. (SOSSUS).

A stated limitation of the utilization model was that it was based on present behavior. If there were dramatic changes in socio-medical or technologic conditions, the model would be a weak forecaster. It should be stated, however, that according to the sample of the NDTI, there was no substantial change in number of office visits from 1970 to 1980.

Assumptions/Underlying Factors:

Prevalence of Disease Conditions (A)(3)
Consideration of Selected Disease Conditions (B)(3)
Utilization Rates (visits/week or year) (G)(2)
Time Required to Produce Services or Visits (H)(2)
Case Loads Per Health Professional (I)(1/2/3)

Reference No. 45	Report to the President and Congress on the Status of Health Personnel in the United States

Author(s): U.S. Department of Health and Human Services, Bureau of Health Professions, Health Resources and Services Administration

Publication Information: May 1984

Sponsor: Bureau of Health Professions, Health Resources and Services Administration

Professions Covered: Medicine; Dentistry; Podiatry; Veterinary Medicine; Physician Assistants; Optometrists; Pharmacy; Nursing; Allied Health Personnel

Abstract:

The purpose of this congressionally-mandated report (the fourth in a series) was to provide information on health personnel status, recent developments, problems, and issues relating to supply requirements and distribution.

Projections of physician, optometrist, pharmacist, and veterinarian requirements were obtained using the BHPr general requirements model. Theadjusted utilization model estimated current levels of utilization by accounting for projected population changes, trends in per capita utilization, and other factors. The report also contained a discussion of GMENAC findings. The BHPr econometric model of the dental sector was discussed in the section on dental supply and requirements. Projections of requirements for registered nurses were based upon two approaches, the historical/trend based and criteria-based models, built upon those used in previous nursing congressional reports. The following table outlines the projected requirements for selected health occupations in 1990 and 2000.

Details on methodologies for all of the requirements estimates except nursing are presented in the "Third Report to the President and Congress." Details on methodologies for nursing requirements estimates are described in Nurse Supply, Distribution and Requirements. Second Report to the Congress March 15, 1979.

Assumptions/Underlying Factors:

Changing Definitions of Health (F)(3)
Utilization Rates (G)(2)
Technological Advances (J)(3)
Task Delegation (K)(3)
Setting of Care (M)(1/3)
Role Definition of Health Professionals (N)(3)
Patient Subpopulations (O)(1/3)
Health Insurance Coverage (R)(1/3)
Health Insurance Cost-Sharing (S)(1/3)
Household/Individual Demographics (T)(1)
Type of Service (W)(3)
Cost of Service (1/3)

Table 1. Supply and Requirements for Selected Health Occupations, 1980 Supply and Projections for 1990 and 2000

Health Occupation	1980	1990		2000	
	Supply	Supply	Requirements	Supply	Requirements
Physicians (MD and DO)	457,500	594,600	559,300	706,500	654,700
Podiatrists	8,900	13,000	*	17,700	*
Dentists	126,240	151,300	154,300	164,200	168,200
Optometry	22,400	26,900	26,500	31,300	30,665
Pharmacy[1]	139,700	162,200	160,000	174,400	173,900
Veterinary Medicine	36,000	49,800	*	62,700	55,900
Registered Nursing[1]	1,068,000	1,383,200	----	1,562,200	----
Historical Trend	----	----	1,320,400 1,695,600	----	1,576,000 2,344,200
Criteria Based	----	----	1,983,700 2,577,100	----	2,308,400 2,964,400

1/ Full-time equivalents
* Data unavailable

Reference No. 46	**The Health Professions Requirements Model -- Structure and Application**
Author(s):	U.S. Department of Health and Human Services, Public Health Service, Health Resources Administration, Bureau of Health Professions, Division of Health Professions Analysis
Publication Information:	DHHS Publication Number (HRA) 81-15
Sponsor:	Same as author above.
Professions Covered:	General Medicine (includes General and Family Practice, Internal Medicine, and Specialty Unspecified that were assumed to predominately provide primary care); Pediatricians, OB/GYN, Ophalmologists, Psychiatrists; Surgeons (includes General Surgery, Neurological Surgery, Orthopedic Surgery, Otolaryngology, Plastic Surgery, Colon and Rectal Surgery, Thoracic Surgery, Urology and Anesthesiology); Secondary Specialists (includes Allergy, Cardiovascular Diseases, Dermatology, Gastroenterology, Pediatric Allergy, Pediatric Cardiology, Pulmonary Diseases, Radiology, Diagnostic Radiology, Therapeutic Radiology, Neurology, Physical Medicine and Rehabilitation, and "Other Specialties"); Non-Care Specialtists (includes Occupational Medicine, General Preventive Medicine, Public Health, Aerospace Medicine, Forensic Pathology, and Pathology)

Abstract:

The purpose of this report was to describe the health manpower requirements forecasting model of the Bureau of Health Professions (BHPr) of the Department of Health and Human Services that was used to project health manpower requirements for 1990. The model was basically a demand-based model that primarily used population and utilization rates data to project manpower requirements for 28 types of health personnel. It was based on the primary assumption that "recent and current patterns of health services utilization, employment, and productivity will continue into the future." The base year of the model was 1975 and health professions requirements projections werecalculated for the years 1980, 1985 and 1990.

Historic utilization, price, and coinsurance data were used to estimate utilization growth adjustments. Estimates of coinsurance with and without National Health Insurance (NHI) were used to estimate the demand shift due to the potential implementation of NHI. Estimates of base year personnel, utilization, and population as well as future population projections were combined with the estimates of NHI demand shift and utilization growth adjustments to produce future personnel requirements.

Reference No. 47	Report of the Graduate Medical Education National Advisory Committee to the Secretary, Department of Health and Human Services, Volume II: Modeling, Research, and Data Technical Panel
Author(s):	U.S. Department of Health and Human Services, Public Health Service, Health Resource Administration, Office of Medical Education, Graduate Medical Education National Advisory Committee
Publication Information:	DHHS Publication No. (HRA) 81-652, 1981
Sponsor:	U.S. Department of Health and Human Services, Public Health Service, Health Resources Administration, Office of Graduate Medical Education
Professions Covered:	Allergy and Immunology; Anesthesiology; Cardiology; Child Psychiatry; Dermatology; Emergency Medicine; Endocrinology; Gastroenterology; General/Family Practice; Hematology/Oncology (includes neoplastic diseases); Infectious Diseases; Internal Medicine (General - includes diabetes, geriatrics and nutrition); Neonatality; Nephrology; Neurology (includes pediatric neurology); Neurosurgery; Nuclear Medicine; Obstetrics/Gynecology; Ophthalmology; Orthopedic Surgery; Osteopathic General Medicine; Otolaryngology; Pathology; Pediatric Allergy; Pediatric Cardiology; Pediatric Endocrinology; Pediatric Hematology/Oncology; Pediatric Nephrology; Neurology; Pediatrics (General); Physical Medicine & Rehabilitation; Plastic Surgery; Preventive Medicine (includes public health, occupational medicine, and aerospace medicine); Psychiatry (General); Pulmonary Diseases; Radiology; Rheumatology; Surgery (General - includes colon and rectal surgery, pediatric surgery and portions of vascular surgery); Thoracic Surgery; Urology

Abstract:

The major objectives of the Modeling Panel of the Graduate Medical Education National Advisory Committee (GMENAC) were: (1) to estimate physician manpower requirements for 1990 for 23 physician specialty fields; (2) to project 1990 physician supply for the 23 specialty fields; and (3) to make recommendations regarding graduate medical education to achieve a national balance between projected supply and requirements based on their research activities. This abstract summarized the efforts of the GMENAC Modeling Panel to estimate specialty-specific physician manpower requirements. In order to estimate physician manpower requirements for 1990, the Modeling Panel developed and adopted the GMENAC Manpower Requirements Model, a generic adjusted needs-based model that used a needs-based model structure as a base while incorporating factors inherent to demand-based models. The model was considered "generic" because it could be applied to each specialty area by incorporating specific-specialty-related factors. The model was applied to the specialties outlined above except Anesthesiology, Nuclear Medicine, Pathology, Physical Medicine & Rehabilitation, Neurology and Radiology. Their requirements estimates were based on literature reviews. Refer to reference 10 for these estimates. (Cont'd)

The BHPr health manpower requirements model estimated the numbers of health personnel that will be needed in future years to deliver the pattern of health services that currently exists in the nation. The estimates presented in the "basic" column were the health personnel requirements estimates resulting from the projected changes in utilization. The estimates presented in the "revised" column were the estimates resulting from the total application of the model. These estimates have been adjusted to correspond to 1975 supply estimates. See Reference 57 for the most recent estimates using this model.

Assumptions/Underlying Factors:

Changing Definitions of Health (F)(3)
Utilization Rates (G)(2)
Technological Advances (J)(3)
Task Delegation (K)(3)
Setting of Care (M)(1/3)
Role Definition of Health Professionals (N)(3)
Patient Subpopulations (O)(1/3)
Health Insurance Coverage (R)(1/3)
Health Insurance Cost-Sharing (S)(1/3)
Household/Individual Demographics (T)(1)
Type of Service (W)(3)
Cost of Service (1/3)

The generic GMENAC Manpower Requirements Model required the following calculations for each field of specialty: Adjusted-needs for care (P1 (Parameter #1)); P1 multiplied by norms of care ($P2_1$) (by condition) less delegation and substitutability by nonphysician providers ($P2_2$) which equals physician service requirements ($P2_3$); $P2_3$ divided by physician productivity by specialty (P3) which equals the full-time equivalents (FTEs) physicians for patient care ($P3_1$) plus the physician requirements for nonpatient care ($P3_2$) which equals the total head count of physicians required by each specific field of specialty (P4).

GMENAC's final manpower requirements estimates represented the middle position of a range of estimates developed through the application of the Physician Manpower Requirements Model (see the following table). These estimates reflect a "compromise" between the level of manpower that was actually needed and the level of manpower that was truly attainable by 1990 given the projected needs of the disadvantaged and medically underserved populations, physician geographic distribution, cultural attributes, and consumer education efforts. GMENAC also estimated the supply of specialty physicians in 1990 and projected the balance of the supply and requirements for 1990 (see following table).

Assumptions/Underlying Factors:

Prevalence/Incidence of Disease Conditions (A)(1/3)
Consideration of Selected Disease Conditions (B)(2)
Requirements for Preventive Care (D)(3)
Quality of Care (E)(3)
Changing Definitions of Health (F)(3)
Utilization Rates (G)(1/3)
Time Required to Produce Services or Visits (H)(1/3)
Case Loads Per Health Professional (I)(1/3)
Task Delegation (K)1/3)
Setting of Care (M)(1/3)
Role Definition of Health Professional (N)(1/3)
Patient Subpopulations (O)(1)
Health Condition (U)(1/3)
Type of Service (W)(1/3)
Geographic Location (X)(1/(3)
Physician Density (Y)(1/3)

Table 1. GMENAC Estimates of Physician Supply and Requirements For 1990

	1990 Supply	1990 Requirements Range	1990 Req. Midpoint	Surplus (Shortage)
All Physicians	535,750	441,000-490,050	460,000	75,750
Specialties Modeled:				
Osteopathic General Practice	23,850	81,000-87,000	22,700	1,150
General/Family Practice	64,400	---	61,300	3,100
General Pediatrics	37,750	29,000-31,500	30,250	7,500
Pediatric Allergy	900	800-1,000	900	0
Pediatric Cardiology	1,000	1,100-1,200	1,150	(150)
Pediatric Endocrinology	250	700-850	800	(550)
Pediatric Hematology/Oncology	550	1,600-1,700	1,650	(1,100)
Pediatric Nephrology	200	300-350	350	(150)
Neonatalogy	700	1,250-1,350	1,300	(600)
General Internal Medicine[1]	73,800	65,000-75,000	70,250	3,550
Allergy and Immunology	3,050	1,900-2,200	2,050	1,000
Cardiology	14,900	7,500-8,000	7,750	7,150
Endocrinology	3,850	1,900-2,200	2,050	1,800
Gastroenterology	6,900	6,000-7,000	6,500	400
Hematology/Oncology[2]	8,300	8,900-9,100	9,000	(700)
Infectious Diseases	3,250	2,000-2,500	2,250	1,000
Nephrology	4,850	2,500-3,000	2,750	2,000
Pulmonary Diseases	6,950	3,500-3,700	3,600	3,350
Rheumatology	3,000	1,500-1,900	1,700	1,300
Dermatology	7,350	6,700-7,200	6,950	400
General Psychiatry	30,500	37,000-40,000	38,500	(8,000)
Child Psychiatry	4,100	8,000-10,000	9,000	(4,900)
Obstetrics/Gynecology	34,450	23,000-25,000	24,000	10,450
General Surgery[3]	35,300	23,000-24,000	23,500	11,800
Neurosurgery	5,100	2,500-2,800	2,650	2,450
Ophthalmology	16,300	11,400-11,800	11,600	4,700
Orthopedic Surgery	20,100	14,700-15,500	15,100	5,000
Otolaryngology	8,500	7,900-8,100	8,000	500
Plastic Surgery	3,900	2,550-2,800	2,700	1,200
Thoracic Surgery	2,900	2,000-2,100	2,050	850
Urology	9,350	7,500-7,800++	7,700	1,650
Emergency Medicine	9,250	13,000-14,000	13,500	(4,250)
Preventive Medicine[4]	5,550	6,800-7,800	7,300	(1,750)

1 Includes diabetes, geriatrics and nutrition)
2 Includes neoplastic diseases
3 Includes colon and rectal surgery, pediatric surgery and portions of vascular surgery
4 Includes public health, occupational medicine, and aerospace medicine
5 Includes pediatric neurology

Reference No. 48	**A Proposed Demand-Productivity Model for the Designation of Podiatric Manpower Shortage Areas**

Author(s): U.S. Department of Health, Education, and Welfare, Bureau of Health Manpower

Publication Information: July 11, 1978

Sponsor: Manpower Analysis Branch, Office of Program Development of the Bureau of Health Manpower

Professions Covered: Podiatry

Abstract:

This document presented a modified demand/productivity model for the field of podiatry, to determine criteria for the designation of health manpower shortage areas. This was required of the Secretary of HHS by the Health Professions Educational Assistance Act (Pl 94-484). The model was required to take into consideration the ratio of available manpower to the number of individuals in the designated area, the indicators of need for service, i.e., health status, and the percentage of physicians who were foreign medical graduates or hospital based.

The modified demand-productivity model, in its generalized form, means that the number of providers needed per given area is equal to the annual volume of services demanded by the inhabitants divided by the average annual productivity per provider. There were three modifications to this model. The first was that output was expressed as the minimum provider to population ratio needed for the area to conform to the requirements of the law. Productivity rates used were reasonably attainable since productivity was a function of consumer demand and current providers could alleviate a shortage if they operate at above average productivity. The third modification was a provision added for possible utilization of providers in neighboring areas or with substitutable skills such as orthopedic surgeons or general practitioners.

The following figure presents a summary of the standard equations for the determination podiatric shortage areas in the U.S.

Assumptions/Underlying Factors:

Utilization Rates (G)(1)
Task Delegation (K)(4)
Household/Individual Demographics (T)(1)
Physician Density (Y)(1)

Reference No. 49	**Evaluation of Health Manpower Shortage Area Criteria**

Author(s): Mathematica Policy Research

Publication Information: DHEW Publication Numbers (HRA) 80-20

Sponsor: U.S. Department of Health, Education and Welfare, Public Health Service

Professions Covered: Medicine; Podiatry; Psychiatry; Dentistry, Primary Care Medicine

Abstract:

The purpose of this report was to evaluate the Health Manpower Shortage Area (HMSA) criteria. There were five sections to this document--providing a detailed explanation of criteria, a literature review, an evaluative discussion of comments on the criteria, an independent analysis, and conclusions and recommendations.

The analysis was conducted using a Canadian data set that allowed the criteria to be evaluated within an urban context. The objectives of the analytical plan were to designate HMSAs for Montreal and Quebec City and to find out whether residents in designated shortage areas have poorer access to primary care services.

Three analytical approaches were used: (1) Small areas were calculated for utilization measures for five age-sex groups for the years 1971 and 1975, and the means were analyzed to see whether HMSAs tend to exhibit lower utilization rates than non-HMSAs; (2) means were calculated for utilization meaures in each group for insurance beneficiaries in shortage areas; and (3) multiple regression analysis was used to estimate an econometric model in which utilization is a function of area variables, and sex and age are held constant. Data came from four sources: a beneficiary utilization file, a telephone survey of general practitioners in Quebec, the Canadian Medical Directory, and the Census Bureau of Canada.

The population-manpower ratios designated that indicate "relative adequacy," are as follows: Primary Care Physicians 2,500:1; Dentists 3,000:1; Psychiatrists 20,000:1; Podiatrists 20,000:1.

Assumptions:

Utilization rates (9)(2)
Household/Individual Demographics (T)(2)
Geographic Location (X)(2)

Figure 1. Standards for the Designation of Podiatric Shortage Areas in the United States (DHHS, 1978)

A health service area is considered a shortage area if the current ratio of podiatrists to the total population of the area is less than:

$$\frac{0.13 + 0.39p_1 - 0.08\ p^2}{5{,}000 - 1{,}000\ p_3}$$

where p_1 = percent of area residents who are 65 years or older;
p_2 = percent of area residents who are 16 years or younger; and
p_3 = percent of active podiatrists who are 55 years or younger.

These requirements can be waived if the area can be combined with a contiguous area to achieve a suitable ratio or if the following can be satisfied:

$$N_p + 0.15\ N_{os} + 0.02\ N_{gp} \geq \text{area population} \times \frac{0.18 + 0.39_{p1} - 0.08_{p2}}{0.13 + 0.39_{p1} - 0.08_{p2}} \times$$

where N_p = number of area podiatrists in active practice
N_{os} = number of area orthopedic surgeons in active practice
N_{gp} = number of area general practitioners in active practice

Reference No. 50	**Projections of National Requirements for Dentists: 1980, 1985 and 1990**

Author(s): U.S. Department of Health, Education and Welfare, Public Health Service, Health Resources Administration, Bureau of Health Manpower, Division of Dentistry

Publication Information: July 1977

Sponsor: DHEW

Professions Covered: Dentistry

Abstract:

The purpose of this document was to compare the projected future output of dental personnel with projected future requirements so that an assessment of the adequacy of anticipated output can be used as a guide for formulating public policy on dentistry.

The model employed was the simultaneous supply-demand system that estimated the national aggregate demand and supply functions for dental services with time-series data.

The variables considered to affect demand were price of services, national personal income, size of the population and the extent of third party payment. The variables determined to affect supply were price of services, number of dentists, and the state of technology. The historical effects of these variables on demand and supply from 1950 to 1970 were examined using a statistical model of demand and supply. Fitting the model to the historical data yielded estimates of the impact of changes in variables over time on supply and demand. To determine future requirements, future demand was basis projections of the growth of the population, the economy, and prepaid dental benefits. The number of dentists required to meet projected demand was calculated for 1980, 1985 and 1990.

Assumptions/Underlying Factors:

Technological Advances (J)(3)
Task Delegation (K)(1)
Health Insurance Coverage (R)(1)

Reference No. 51	Physician Manpower in Allergy and Immunology

Author(s): U.S. General Accounting Office, Ad Hoc Committee

Publication Information: No date

Sponsor: U.S. General Accounting Office

Professions Covered: Allergy and Immunology

Abstract:

In 1976 a survey was conducted by an ad hoc committee of the General Accounting Office, which included members of the American Academy of Allergy and Immunology, the American Board of Allergy and Immunology, and a Conjoint Board of the American Board of Internal Medicine and the American Board of Pediatrics to obtain opinions from 37 leaders in allergy and immunology. The survey provided an "expert consensus" on the current need for allergy physician manpower and an assessment of whether the number of physicians being trained in allergy was sufficient to fulfill these needs. In response to the question, "what is a reasonable ratio of allergists and immunologists to population?", the respondents gave answers ranging from 1/5,000 to 1/500,000 with the greatest number of ratio estimations being 1/40,000 or 1/50,000.

The committee believed this figure to be "approximately correct," in that if 15% of the population was allergic as estimated by the National Institute of Allergy and Infectious Diseases, then a ratio of 1/50,000 would provide one specialist for every 7,500 individuals. Responses pertaining to the number of allergic patients that one specialist could provide care for support this given ratio. The ratio suggested that approximately 4,500 specialists in allergy and immunology were needed in 1976 to deliver care according to the 1/50,000 population standard. The committee also estimated that 400 additional physicians were needed for teaching and research in allergy and immunology.

Assumptions/Underlying Factors:

Practice Characteristics (1/3)

Reference No. 52	Primary Care Service

Author(s): Utah Health Systems Agency

Publication Information: Chapter of the Health Systems Plan; February 4, 1981

Sponsor: U.S. General Accounting Office

Professions Covered: Primary Care Medicine

Abstract:

This section on primary care provided a definition of primary care and describes its functions, presented background on its relationship to health status and problems of availability of information, and gives information on comparative supply, specialty and geographic distribution, types of practice, and service areas for Utah, the United States, and the Mountain Region. Estimates of required primary care physicians were determined taking estimated primary care office visits and dividing by the average office visits per year per physician (or physician productivity estimates). These were based on estimates of current productivity of physicians in nonmetropolitan areas of the U.S. The average office visits per year per primary care physician in a given community is a weighted average of productivity of the specialties in the community.

Assumptions:

Utilization Rates (G)(2)
Case Loads Per Health Professional (I)(2)

Table 1. Primary Care Visits and Physicians Available and Required by County 1980

County	Goal FTE Primary Care Physicians Required	FTE Primary Care Physicians Available	Physician Surplus (Deficit)
Box Elder	13-14	16.5	2-3
Cache	24-25	26.5	1.5-2.5
Rich	0-1	0.0	(0-1)
Davis	NA	NA	NA
Morgan	2-3	2.0	0
Weber	NA	NA	NA
Salt Lake	NA	NA	NA
Tooele	9-10	4.5	(5-6)
Summit	3-4	6.75	2-4
Utah	NA	NA	NA
Wasatch	3-4	5.25	1-2
Juab	2-3	2.0	(0-1)
Millard	3-4	3.0	(0-1)
Piute	0-1	0.4	(0-.5)
Sanpete	5-6	10.0	4-5
Sevier	5-6	4.0	(1-2)
Wayne	0-1	0.0	(0-1)
Beaver	1-2	2.0	(0-1)
Garfield	1-2	1.6	(0-.4)
Iron	7-8	9.5	1-2
Kane	1-2	3.0	1-2
Washington	10-11	9.0	(1-2)
Daggett	0-1	0.0	(0-1)
Duchesne	4-5	5.0	0
Uintah	7-8	4.1	(3-4)
Carbon	10-11	10.5	(0-.5)
Emery	4-5	1.0	(3-4)
Grand	2-3	3.0	0-1
San Juan	7-8	4.0	(3-4)

Reference No. 53	Surgery and the GMENAC Report: A Reality Test

Author(s): Williams, Donald C., M.A.

Publication Information: Surgery, Vol. 95, No. 3 (March 1984), pp. 347-352

Sponsor: Office of Health Systems Planning, Rhode Island Department of Health

Professions Covered: General Surgery, Neurosurgery, Obstetrics and Gynecology, Ophthalmology, Orthopedic surgery, Otolaryngology, Plastic Surgery, Thoracic Surgery, Urology

Abstract:

The purpose of this study was to provide a "reality test" for the projected 1990 surgical use rates from the Graduate Medical Education National Advisory Committee (GMENAC) and the related 1990 surgical specialty manpower requirements for the U.S. The study also provided a comparison of the GMENAC analyses for 1990 surgical practice in the U.S. with the actual 1970 surgical practice in Rhode Island as outlined by the Study of Surgical Services in the U.S. (SOSSUS). Williams used the GMENAC approach to estimate the parameter of surgical work load based on the quantitative methodology of the 1970 SOSSUS, or more specifically the California Relative Value Units (CRVs) used to weight surgical procedure complexity. Specialist-specific CRV-weighted work load per surgeon were calculated based on Williams derived CRV-weighted estimates for total primary surgical procedures to be performed in the U.S. in 1990. The specialist-specific CRV-weighted method used data compiled by GMENAC for the projected use of operative procedures per 100,000 population, 1990 population projections (U.S. Census Bureau), and a method to assign CRV weights to each primary operative procedure. Speciality-specific average CRV-weighted work loads per surgical specialist were calculated. Williams used a standard norm of 3000 CRVs per surgeon based on a suggestion from Harvard researchers and supporting work load studies to estimate surgical specialist manpower requirements. The CRV-weighted primary procedure estimates for each specialty were divided by 3000 CRVs to yield the 1990 surgical manpower requirements. For all specialities, except plastic surgery and thoracic surgery, GMENAC manpower estimates are higher (see table I). However, this article focused on the operative aspects of surgical specialty practices, whereas GMENAC also considered non-operative factors such as non-operative hospital and ambulatory case loads.

Assumptions/Underlying Factors:

Prevalence/Incidence of Disease Conditions (A)(2)
Consideration of Selected Disease Conditions (B)(2)
Case Loads Per Health Professional (2/3)

Table 1. Surgeon Supplies and Alternate Requirements for 1990

		GMENAC		3000 CRV norm	
	Projected Supply	Requirement	Surplus (deficit)	Requirement	Surplus (deficit)
General Surgery	35,300	23,500	11,800	21,883	13,417
Neurosurgery	5,100	2,650	4,450	2,468	2,632
Ophthalmology	16,300	11,600	4,700	4,033	12,267
Orthopedic Surgery	20,100	15,100	5,000	14,374	5,726
Otolaryngology	8,500	8,000	500	4,135	4,365
Plastic Surgery	3,900	2,700	1,200	4,228	(328)
Thoracic Surgery	2,900	2,050	850	5,200	(2,300)
Urology	9,350	7,700	1,650	7,429	1,921
Obstetrics and Gynecology	34,450	24,400	10,450	15,572	18,878
Total	135,900	973,000	38,600	79,322	56,578

Reference No. 54	Wisconsin Physician Supply and Requirements Projections for the Year 2000

Author(s): Division of Health, Wisconsin Department of Health and Social Services

Publication Information: December, 1982

Sponsor: Division of Health, Wisconsin Department of Health and Social Services

Professions Covered: Medicine

Abstract:

This report was submitted as part of a mandated study of Wisconsin's physician requirements and supply for the year 2000. The Department of Health and Social Services of the state of Wisconsin used GMENAC approaches as a starting point for establishing future requirements and supply. A discussion of types of physician supply and requirements models and their advantages and disadvantages was contained in the report.

A utilization model was developed for this study's requirements section. The model calculated physician requirements by employing current utilization data (1980-1981) to estimate the number of physician visits that will be made annually by people in different sex and age groups. This number was multiplied by the number of individuals projected for that group. Current data were used to allocate visits to specialty groups. The estimated annual number of visits for each specialty was divided by the visits the physician can handle (based on productivity data). The resulting requirements figures ranged from 7,464 to 10,449 physicians. Various assumptions relating to potential increases and/or decreases in demand for services, and the number of physician patient contacts (from 2-3), were applied to produce totals falling within the above range. Population projections for the model were based on the ratio of intercensal cohort change (1980/1970) applied to 1980 census counts.

Assumptions/Underlying Factors:

Utilization Rates (G)(2)
Case Loads Per Health Professional (I)(2)
Time Required to Produce Services or Visits (H)(2)
Household/Individual Demographics (T)(2)

Reference No. 55	**Wisconsin Physician Supply and Requirements Projections for the Year 2000—An Update**

Author(s): Wisconsin Department of Health and Social Services, (Redding, L.E.); Bureau of Planning and Development, Division of Health, Department of Health and Social Services

Publication Information: February, 1985

Sponsor: Department of Health and Social Services

Professions Covered: Medicine

Abstract:

Following its 1982 study and the production of an initial report on physician supply and requirements for the state of Wisconsin in the year 2000, the Department of Health and Social Services was directed through further legislative action to continue its assessment. This updated report used the same methodological approaches as applied in the 1982 study with some revision to account for the availability of new population projections for 2000, more detailed data on groups in the 65 and older age categories, and more recent research findings related to productivity data.

The utilization model described in the 1982 study was used to predict physician requirements in this updated report. Future physician requirements were based on the amount of health care consumed by Wisconsin residents, with estimates calculated to reflect new population projections. Updated information on hospitalization rates and length of hospital stay was not available. New forecasts for the number of physicians needed randged from a low 7,964 in 1990 to a high of 9,023 in 2000. (see abstract of 1982 study report: Wisconsin Physician Supply and Requirements Projections for the Year2000 for a description of the utilization model.) The following table presents the estimated number of physicians needed in Wisconsin for the years 1990 and 2000.

Assumptions/Underlying Factors:

Utilization Rates (G)(2)
Time Required to Produce Services or Visits (H)(2)
Household/Individual Demographics (T)(2)

Table 1. Estimated Number of Physicians Needed in Wisconsin in 1990 and 2000

	1990-Low*	1990-High*	2000-Low*	2000-High*
Office-Based Specialties[1]	5,843	6,387	6,309	6,902
Hospital-Based Specialties[2]	1,434	1,434	1,434	1,434
Non-Patient Related[3]	560	560	560	560
Other[4]	127	127	127	127
Total	7,964	8,508	8,430	9,023

Footnotes:

1/ Estimates were based on an average productivity rate of 5,635 and calculated from "Medical Practice in the United States" (Robert Wood Johnson Foundation) data on weekly average ambulatory and hospital encounters and percent share of total encounters.

2/ "Hospital-Based" specialty estimates--anesthesiology, pathology, radiology and emergency medicine--are based on the Graduate Medical Education National Advisory Committee, GMENAC, requirement ratios per specialty per 100,000 population. Respectively the ratios are: 8.6, 5.5, 7.4, and 5.5.

3/ "Non-Patient Related" estimates are based on the 1980 number of Wisconsin physician teachers, researchers, and administrators.

4/ "Other" estimate includes physical medicine and rehabilitation at 1.3 per 100,000 and miscellaneous at 1.1.

*Low estimates include 2 visits/M.D./day/patient; high estimates include 2.5 visits.

Assumptions:

Utilization Rates (G)(2)
Time Required to Produce Services or Visits (H)(2)
Household/Individual Demographics (T)(2)

Reference No. 56	Summary Report of the Joint Commission on Neurology

Author(s): Yahr, Melvin D.

Publication Information: Neurology, Vol. 25 (June 1975), pp. 497-501

Sponsor: American Neurological Association
National Institute of Neurological Diseases and Stroke

Professions Covered: Neurology (not broken down into subspecialtis)

Abstract:

This document reported the findings of the Joint Commission on Neurology that was established in 1970 to assess the present and anticipated needs for neurologic manpower. The estimate of manhours required to meet patient care needs was based upon the incidence and prevalence of the most common neurological disorders the degree of responsibility that neurologists rather than primary care physicians should assume, and the frequency and length of neurologist-patient contact appropriate for each of the common disorders. This report combined the medical-needs based approach with the demand/productivity approach.

The calculations revealed that sixteen million manhours per year were required. Each neurologist, defined as a trained physician considering himself a neurologist, practices patient care approximately 30 hours per week. Based on these figures, 10,000 neurologists were needed. (16,000,000 hours/year divided by 1,560 hours/year/neurologist.) It was projected that by 1985, 12,000 to 13,000 neurologists will be required.

Assumptions/Underlying Factors:

Prevalence of Disease Conditions (A)
Consideration of Selected Disease Conditions (A)(1)
Utilization Rates (G)(1)
Time Required to Produce Visits or Services (H)(1)

APPENDIX A

BIBLIOGRAPHY OF DOCUMENTS ABSTRACTED

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APPENDIX B

STUDIES REVIEWED AND EXCLUDED

APPENDIX B

STUDIES REVIEWED AND EXCLUDED

STUDY/AUTHOR/EDITOR	SHORT TITLE	REASON EXCLUDED*
AANA	Membership Survey Results	G
Abt Associates	Planning for Physician Requirements	B,D
Abt Associates	Review of Forecasting	B,D
Adams, F.H., and Mendenhall, R.C.	Profile of the Cardiologists	E
Alabama Comprehensive Health Planning Administration	Physician Manpower Study Phase II	G
Alabama State Board of Health	Plan of Action	F,G
Albee, G.W.	Psychiatry's Human Resources	G,G
Ament, R.	Anesthesia and Surgical Care	D
Ament, R., and Kitz, R.J.	1974 ASA Membership Survey	E,B
Amer. Academy of Pediatrics	Report of Task Force	G
Amer. Academy of Child Psych.	Child Psychiatry	G
Amer. Assoc. of Nurse Anesthetists	Guidelines	G
Amer. Society of Allied Health Professionals	Draft--Proceedings	G
Amer. Parmaceutical Assoc.	Final Report of Task Force	G
Amer. Podiatry Association	Assessment of Foot Health Problems	K
Amer. Academy of Pediatrics	Critique of Final Report of GMENAC	G
Amer. College of Radiology	Report on ACR Task Force	H
Amer. Health Care Assoc.	Nursing Homes - A Sourcebook	G
Amer. Podiatric Medical Assoc.	APMA Membership Survey	B,I

A - Non-U.S. Study	G - Req's Considered, No Standard Prescribed
B - General Discussion	H - Updated Study
C - Irrelevant Health Manpower	I - Supply Estimates and Projections
D - Methodology Discussion	J - Additional Manpower Needed Estimated; No Original Supply
E - Methodology Unclear	
F - Standard from Other Source	K - Included in Another Report

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STUDIES REVIEWED AND EXCLUDED (Continued)

STUDY/AUTHOR/EDITOR	SHORT TITLE	REASON EXCLUDED*
Amundson, L.H.	Family Physician Needs	E
ASCP/CAP	Pathology Manpower Needs in U.S.	H
Batelle Human Affairs Research Center	1990 Manpower Requirements	K
Bawden, J.W., and DeFriese, G.H.	Planning for Dental Care	B,D,G
Blackstone, E.A.	Market Power and Resource Misallocation	G
Bland, C.S. and Prestwood, J.S.	Physician Need in Minnesota	E
Bloom, B.S., et. al.	Thoracic Surgeons and Their Practice	B,I
Boles, R.	Manpower and Long-Range Planning Report	I
Born, D.O.	Issues in Forecasting	D
Born, D.O. and Barrington, E.P.	Practice Styles and Opportunities	G
Boston University	Primary Care in New England	B,D
Budetti, P.P.	Impending Pediatric Surplus	D
Budetti, P.P., et. al.	Current Distribution and Trends	G
Bui Dang Ha, Doan	Projection with Ref. to Primary Care	G
Burnett, R.D., et. al.	Pediatric Manpower Requirements	B,D
Burnett, R.D., et. al.	Projection of Pediatric Manpower	B,G
California State Dept. of Health	1977 California Health Manpower Plan	F,I
Central NY Health Systems Agency	Technical Notes	D
Central Penn. Health Systems Agency	Summary of Nursing Needs	G
City of Chicago HSA	Health Systems Plan-Chicago	F

A - Non-U.S. Study	G - Req's Considered, No Standard Prescribed
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STUDIES REVIEWED AND EXCLUDED (Continued)

STUDY/AUTHOR/EDITOR	SHORT TITLE	REASON EXCLUDED*
Comprehensive Health Planning-NW IL	1984 80 Health Systems Plan	G,J
Comprehensive Health Planning-NW IL	Health Manpower in NW Illinois	
Cordes, S.M., and Eisele, T.W.	Resource-to-Population Ratios	G
Deeble, J.S. and Harvey, D.R.	Projection Pharmacy Manpower	A
DeFriese, G.H., and Baker, B.D.	Status of Dental Manpower Research	D
DHEW	Analysis of Dental Systems Models	G
DHEW	Baselines for Setting Health Goals	B
DHEW	Determining Manpower Requirements	G
DHEW	Dev. of Procedures for Allied Health Requirements and Supply	C
DHEW	Distribution of Medical Specialty Manpower	D
DHEW	Economic Analysis of Dental Services Markets	G
DHEW	Inventory of Health Manpower Models	G
DHEW	Supply, Need, and Distribution of Anesthesiologists and Nurse Anesthetists	H
DHEW	Target Income Hypothesis	G,D
DHHS	Report of GMENAC Advisory Committee, Vo. III	K
DHHS	Report of GMENAC Advisory Committee, Vo. IV	K
DHHS	Report of GMENAC Advisory Committee, Vo. V	K
DHHS	Report of GMENAC Advisory Committee, Vo. VI	K

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APPENDIX B

STUDIES REVIEWED AND EXCLUDED (Continued)

STUDY/AUTHOR/EDITOR	SHORT TITLE	REASON EXCLUDED*
DHHS	Report of GMENAC Advisory Committee, Vo. VII	K
DHHS	Resource Allocation Reference Manual	D
DHHS	Resource Allocation Workbook	B,D
DHHS	Study of Dental Treatment Production	G
DHHS	Summary Report	K
DHHS	Supply of Dentists, Optometrists, Pharmacists and Veterinarians	I
Dodd, G.D.	Manpower Requirements in Radiology	B
Douglas, C., et. al.	Potential for Increase in Periodontal Diseases	B
Douglas, C.W. and Gammon, M.	Epidemiology of Dental Caries	B,G
Douglas, C.W., et. al.	Estimating the Market	G,B
Gamble, L., et. al.	Opthamology Manpower-Part IV	G
Garrison, L.P, et. al.	Estimating Requirements for Neurologists	H
Goldstein, M.	Neurologist as a Health Resource	F
Gov.'s Advisory Council, MO	Statewide Conference on Manpower	G
Graham, T.P.	Manpower and Training in Pediatric Cardiology	B
Greenbury, C.L.	Manpower In Pathology 1969-1975	H
Griggs, R.C.	Ohio Family Physicians	F,I
Health Planning Council	Plan for Southern Wisconsin	E
Health Planning Council	Planning to Meet Future Need	E
Health Planning Council of Appalachia	Western MD Regional Health Manpower Study	I

A - Non-U.S. Study	G - Req's Considered, No Standard Prescribed
B - General Discussion	H - Updated Study
C - Irrelevant Health Manpower	I - Supply Estimates and Projections
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STUDIES REVIEWED AND EXCLUDED (Continued)

STUDY/AUTHOR/EDITOR	SHORT TITLE	REASON EXCLUDED*
Health Sys. Council, Eastern, PA	Nursing Manpower	J
Health Systems Agency	Health Systems Plan	F
Health Systems Agency of SW Arizona	Chapter IV--State Health Plan	F
Holden, W.D.	Perspective on Physician Manpower	B
Indiana State Board of Health	Distribution of Physicians	I
Indiana State Board of Health	Distribution of RNs	I
Indiana State Board of Health	Indiana Plan for Health	F
Institute of Medicine	Personnel for Biomedical and Behavioral Research	C
Jacoby, I.	Physician Requirements Forecasting	B,D
Johns Hopkins University	Application of GMENAC Model	B,D,G
JRB Associates	Need/Demand Assessment	B,D
Klooster, J.	Dental Manpower	B
Knesper, D.J.	Documenting a Shortage of Psychiatrists	B,G,D
Knesper, D.J.	Psychiatric Manpower	B
Krasner, M., et. al.	Dermatologists for the Nation	F,I
Kriesberg, H.M., et. al.	Methodological Approaches Vol. I	B,D
Kriesberg, H.M., et. al.	Methodological Approaches Vol. II	B,D
Kurtzke, J.F.	Current Neurologic Burden of Illness and Injury	G
Langsley, D.G., et. al.	Hospital and Community Psychiatry	B,I

A - Non-U.S. Study	G - Req's Considered, No Standard Prescribed
B - General Discussion	H - Updated Study
C - Irrelevant Health Manpower	I - Supply Estimates and Projections
D - Methodology Discussion	J - Additional Manpower Needed Estimated; No Original Supply
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APPENDIX B

STUDIES REVIEWED AND EXCLUDED (Continued)

STUDY/AUTHOR/EDITOR	SHORT TITLE	REASON EXCLUDED*
Leeper, J.D.	Dental Care in Alabama	B,G,I
Lewis, C.S., et. al.	Medical Manpower in Oklahoma	F
Liptzin, B.	Psychiatrist Shortage	D
Marshall, E.C.	Report of GMENAC Committee	B
McNutt, D.R.	GMENAC	B,D
McTernan, E.J. and Leikan, A.M.	Pyramid Model of the Health Manpower	I
Mendenhall, R.C., et. al.	Manpower of Obstetrics	B,I
Menken, M.	Coming Oversupply of Neurologists in the 1980s	G
Menken, M.	Physician Requirements in Neurology	B
Messer, R.H., et. al.	Academic Manpower for OB-GYN	C
Meyer, R.	Statewide Survey of Professional Nursing	J
Mississippi Health Care Comm.	State Health Plan	F
Morgan, B.C.	Projecting Requirements for Child Health Care	K
N.C. GA Health Systems Agency	Survey of Footcare Manpower	G
National Research Council	Specialized Veterinary Needs Through 1990	D,F
Navajo Health Authority	Health Manpower Survey Report March 1979	C
Navajo Health Authority	Health Manpower Survey Report Spring 1978	C
Nebraska Dept. of Health	1976 Nebraska Health Manpower Plan	L
Nebraska Dept. of Health	Nebraska's Nurse Supply, Needs, Resources	J
Nebraska Statewide Health Coordination Council	Report of the Ad Hoc Committee on Nursing Manpower	G
NH Department of Health	Health Choices	F

A - Non-U.S. Study	G - Req's Considered, No Standard Prescribed
B - General Discussion	H - Updated Study
C - Irrelevant Health Manpower	I - Supply Estimates and Projections
D - Methodology Discussion	J - Additional Manpower Needed Estimated; No Original Supply
E - Methodology Unclear	
F - Standard from Other Source	K - Included in Another Report

APPENDIX B

STUDIES REVIEWED AND EXCLUDED (Continued)

STUDY/AUTHOR/EDITOR	SHORT TITLE	REASON EXCLUDED*
NY Health Planning Commission	Primary Care Profile	G
NY State Health Advisory Council	Are Nurses in Short Supply?	F
NY State Health Coord. Council	Chapter VI Health Personnel	F
NY State Health Planning Comm.	Primary Care Profile	G
NY State Health Planning Comm.	Toward a Balanced Manpower Policy	I
O'Doherty, D.S.	National Need for Neurologists	G
Office of Health and Medical Affairs	Issues in Health Policy	G,D
Office of Policy Research	Updated AAO Distribution Study	G
Oklahoma Health Planning Comm.	1982 Oklahoma Triennial Health Plan	B
Oklahoma Health Planning Comm.	Distribution of Physician Manpower	I
Oklahoma Health Planning Comm.	Oklahoma Health Data Book	F
Oklahoma Health Planning Comm.	Oklahoma Health Manpower Report 1978-1979	L
Oklahoma Interagency Task Force	Oklahoma Health Manpower Report 1975-1980	Update
Orkin, F.K.	Critique of the Bureau of Health Manpower Estimates	B,G
Pardes, H.	Countering Psychiatry's Manpower Shortage	B,G
Pardes, H.	Future Needs for Psychiatrists	B,G
Pardes, H., and Pincus, A.	Report of GMENAC Committee-Implications for Psychiatry	B
Piedmont Health Systems Agency	Health Systems Plan	F
Ramsay, D.L., et. al.	Dermatology Manpower Projections	I
Reinecke, R.D. and Steinberg, T.	Manpower Studies for the U.S.	G

A - Non-U.S. Study	G - Req's Considered, No Standard Prescribed
B - General Discussion	H - Updated Study
C - Irrelevant Health Manpower	I - Supply Estimates and Projections
D - Methodology Discussion	J - Additional Manpower Needed Estimated; No Original Supply
E - Methodology Unclear	K - Included in Another Report
F - Standard from Other Source	

APPENDIX B

STUDIES REVIEWED AND EXCLUDED (Continued)

STUDY/AUTHOR/EDITOR	SHORT TITLE	REASON EXCLUDED*
Reinhardt, V.E.	The GMENAC Forecast	B
Rhode Island Dept. of Health	Technical Report No. 12	B
Rhode Island Dept. of Health	Technical Report No. 13	D
Rhode Island Dept. of Health	Technical Report No. 20	D,G,F
Rhode Island Dept. of Health	Technical Report No. 22	I
Rhode Island Health Science Education Council	Current Supply of Dental Manpower	K
Riemenschneider, P.A.	Radiology Manpower Update	B,E,G
Riley, T.L., and Menken, M.	Under-or-Over-Supply of Neurologists	G
Ruiz, R.S.	AAO Manpower Studies--Part V	F,D
Schoen, M.H.	Dental Care and the HMO Concept	B,G,I
Schoen, M.H.	Methodology of Capitation Payment	B
Skipper, J.K., and Pippert, J.M.	National Survey of Podiatrists	G
Solberg, A.I.	Survey of Methodologies	D
Spivey, B.	Overview of GMENAC Report	B
Stambler, H.V.	Health Manpower for the Nation	B,D
State Council of Higher Ed.	Health Manpower Study	F
State of Arkansas	Arkansas Health Manpower Resources	G
State of Arkansas	Health Manpower for Arkansas	G,I
State of California	1979 California Health Biennial Update and Geographic Distribution	E,F,G
State of California	1981 California Health Manpower Plan Biennial Update-Trends	F,G

A - Non-U.S. Study	G - Req's Considered, No Standard Prescribed
B - General Discussion	H - Updated Study
C - Irrelevant Health Manpower	I - Supply Estimates and Projections
D - Methodology Discussion	J - Additional Manpower Needed Estimated; No Original Supply
E - Methodology Unclear	K - Included in Another Report
F - Standard from Other Source	

APPENDIX B

STUDIES REVIEWED AND EXCLUDED (Continued)

STUDY/AUTHOR/EDITOR	SHORT TITLE	REASON EXCLUDED*
State of California	Annual Report	B
State of California	Final Report to the Legislature	B
State of Health Planning and Development Agency, MO	State Health Plan	G
State of Nebraska	Results of Nursing Manpower Analysis	E
State of Rhode Island	Rhode Island Health Plan	F
Statewide Health Coord. Council, KS	1984 Plan	I
Thompson, R.H., and Standford, G.	Child Life in Hospitals	B
Tucker, G.J.	The Coming Shortage	B,G
Virginia State Dept. of Health	Virginia State Health Plan	F
Waldman, H.B.	Fine Tuning Change	B
Washington State Department of Social and Health Services	Report: RNs in Washington	B,I
Washington State Department of Social and Health Services	Report: Pharmacists	B,I
Washington State Department of Social and Health Services	Report: Optometrists	B,I
Washington State Department of Social and Health Services	Report: Physical Therapists	B,I
Washington State Department of Social and Health Services	Report: Chiropractors	B,I

A - Non-U.S. Study	G - Req's Considered, No Standard Prescribed
B - General Discussion	H - Updated Study
C - Irrelevant Health Manpower	I - Supply Estimates and Projections
D - Methodology Discussion	J - Additional Manpower Needed Estimated; No Original Supply
E - Methodology Unclear	
F - Standard from Other Source	K - Included in Another Report

APPENDIX B

STUDIES REVIEWED AND EXCLUDED (Continued)

STUDY/AUTHOR/EDITOR	SHORT TITLE	REASON EXCLUDED*
Washington State Department of Social and Health Services	Report: Dentists	B,I
Washington State Department of Social and Health Services	Report: Podiatrists	B,I
Washington State Department of Social and Health Services	Report: Allopathic and Osteopathic Physicians	B,I
Washington State Department of Social and Health Services	Report: Referral Patterns and Attitudes	B
Weary, P.E.	A Surplus of Dermatologists	B,G
Weiner, J.P., et. al.	Analysis of Need for Planning Care Physicians	F
Williams, D.C.	Surgeons and Surgery In Rhode Island	K
Williams, D.C.	Surgery and the GMENAC Report	K
Wills, J.	Survey of Physician Requirements	D
Wills, J., et. al.	Supply and Requirements Radiologists	K
Worthen, D.M., et. al.	Opthamology Manpower-Part III	G

A - Non-U.S. Study	G - Req's Considered, No Standard Prescribed
B - General Discussion	H - Updated Study
C - Irrelevant Health Manpower	I - Supply Estimates and Projections
D - Methodology Discussion	J - Additional Manpower Needed Estimated; No Original Supply
E - Methodology Unclear	
F - Standard from Other Source	K - Included in Another Report

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